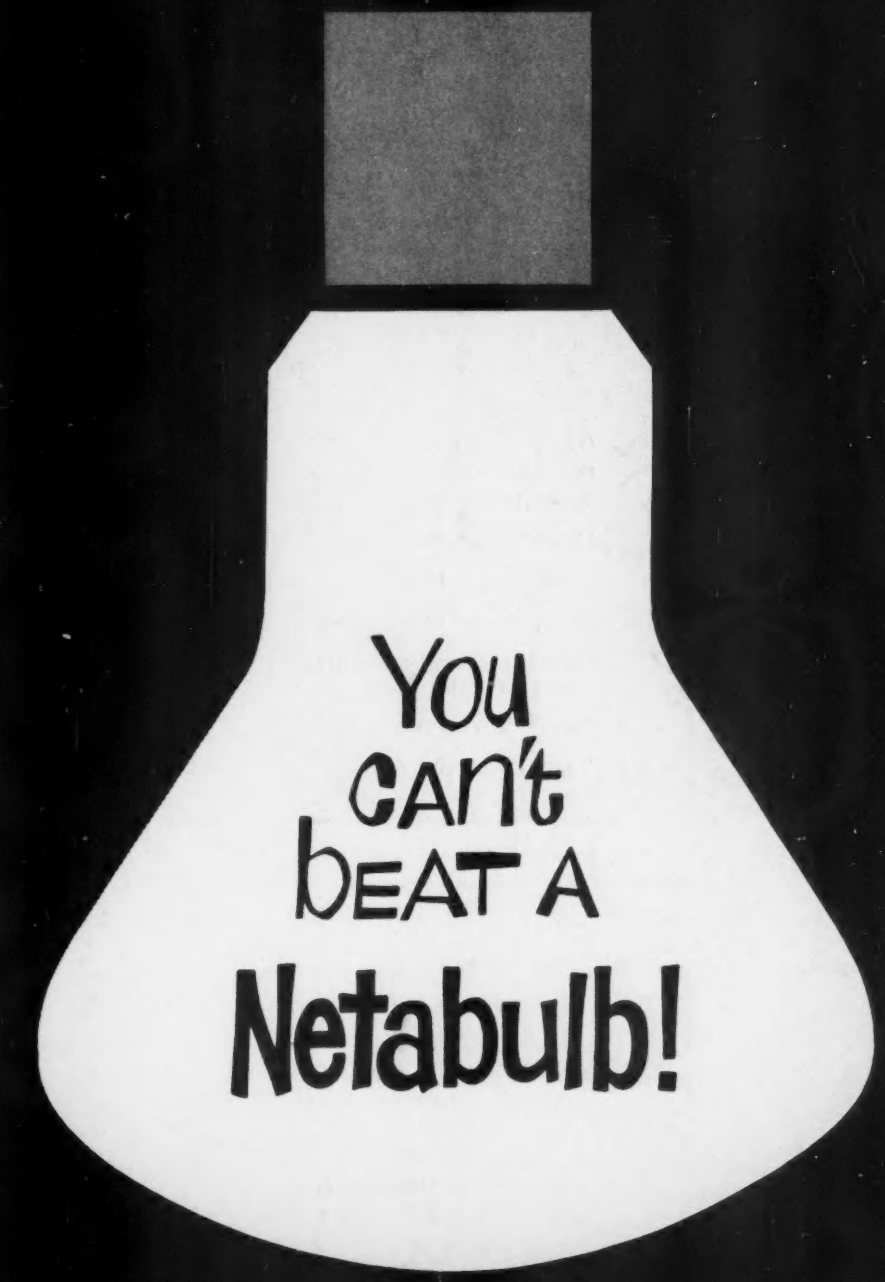
21 DECEMBER 1961

ONE SHILLING AND SIXPENCE

ELECTRICAL TIMES



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16 and 26 ampere

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Trinistor

silicon controlled rectifiers

up to 400 volts rating

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Maximum forward current, 180° conduction	26A	16A
Maximum surge current	580A	360A
Maximum mean gate power	0·5W	0·5W
Maximum sustaining current	50mA	25mA
Maximum forward or reverse leakage current	20mA	20mA
Typical turn on time	2μs	2μs
Typical turn off time	20μs	20μs

Maximum forward and reverse voltage, peak	25	50	75	100	150	200	250	300	350	400
16 ampere	CS32B	CS32C	CS32D	CS32E	CS32G	CS32J	CS32K	CS32L	CS32M	CS32N
26 ampere	CS31B	CS31C	CS31D	CS31E	CS31G	CS31J	CS31K	CS31L	CS31M	CS31N

Applications include, static switching, control systems, regulation and control of a.c. and d.c. supplies, static inverters, constant voltage supplies, etc.

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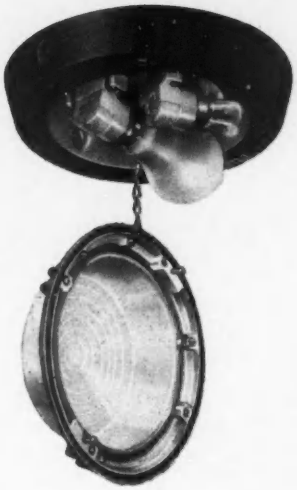
News Items

44 SERVICE BRANCHES COVERING THE BRITISH ISLES WITH AGENTS THROUGHOUT THE WORLD

TIMING SWITCHED SOCKET OUTLETS

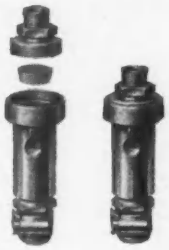
"ORBIT" CIRCULAR LIGHTING FITTINGS MAY NOW BE SUPPLIED IN TWO-LIGHT PATTERN.



An extension to the range of the 'Orbit' Lighting Fittings designed to accommodate two lamps, one of which can be used as a pilot light, or in conjunction with an emergency lighting system.
Complete with B.C. anti-vibration lamp-holder to accommodate a 100 watt lamp and B.C. lamp-holder to accommodate a 15 watt lamp.

A complete range of socket-outlets controlled by a 15 amp. 'A.C. only' time switch. This arrangement enables a socket-outlet to be energised for a pre-determined period of time and only at the end of this period is the supply automatically switched off.
For use with any electrical appliance which needs a supply for a limited period, thus economizing on electricity consumption: IRONS, FIRES, TOASTERS, PUMPS, COOKERS, CONVECTOR HEATERS, ELECTRIC BLANKETS, MIXERS, RADIO AND TV, STERILIZERS IN HOSPITALS.

WEATHERPROOF TYPE CIRCULAR CABLE SEALING BOXES AND GLANDS



A range for L.C.S.W.A. cables, covering sizes from ¾" to 2" conduit.

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PLASTIC COVERS ON BULKHEAD LIGHTING FITTINGS

60 and 150 watt tungsten fittings are now available with high-impact heat-resisting weatherproof plastic covers. For use in subways, mental institutions, food and packaging industries.

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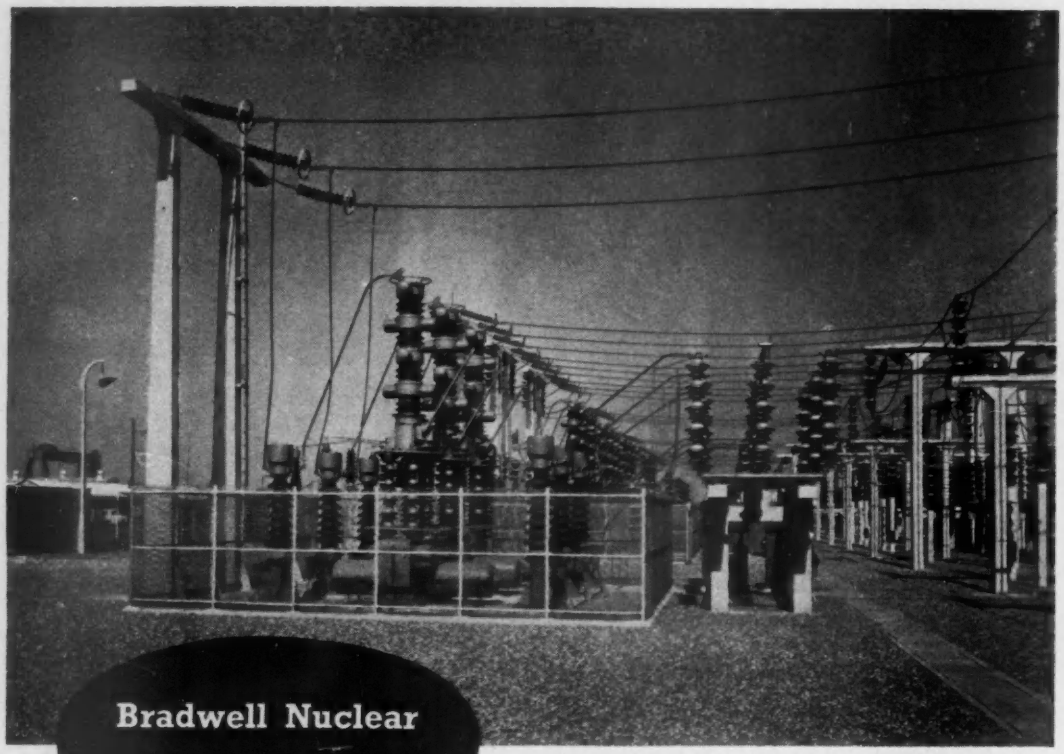

Bradwell Nuclear Power Station

Photograph by courtesy of the C.E.G.B. South Eastern Region

A section of the 132-kV switching station at Bradwell equipped with Reyrolle 3,500-MVA air-blast circuit-breakers.

Reyrolle also supplied through The Nuclear Power Group:

6·6-kV, 3·3-kV, and 415-volt air-break switchgear for station auxiliaries

Remote-control equipment for the switchgear and the reactors

Control-rod heads for the reactors

Burst-slug detection equipment

Stand-by supply equipment

TNPG

Reyrolle

MEMBER OF THE NUCLEAR POWER GROUP

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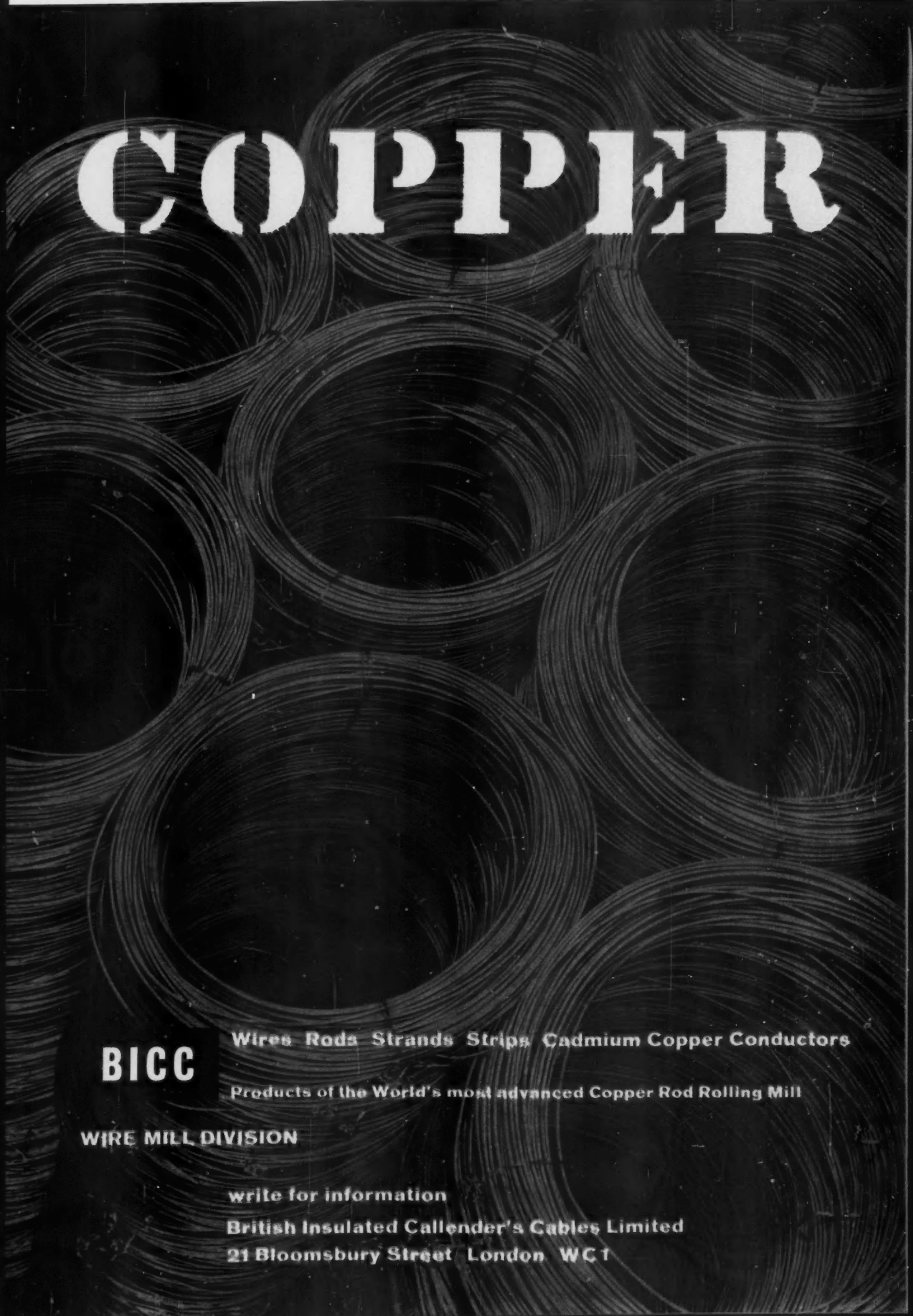
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When you specify Class H insulated motors you are taking a big step in reducing your maintenance problems.

Class H insulation has ten times the life of Class B insulation when working under the same conditions, so the risk of insulation failure—a major cause of motor breakdowns—is virtually eliminated.

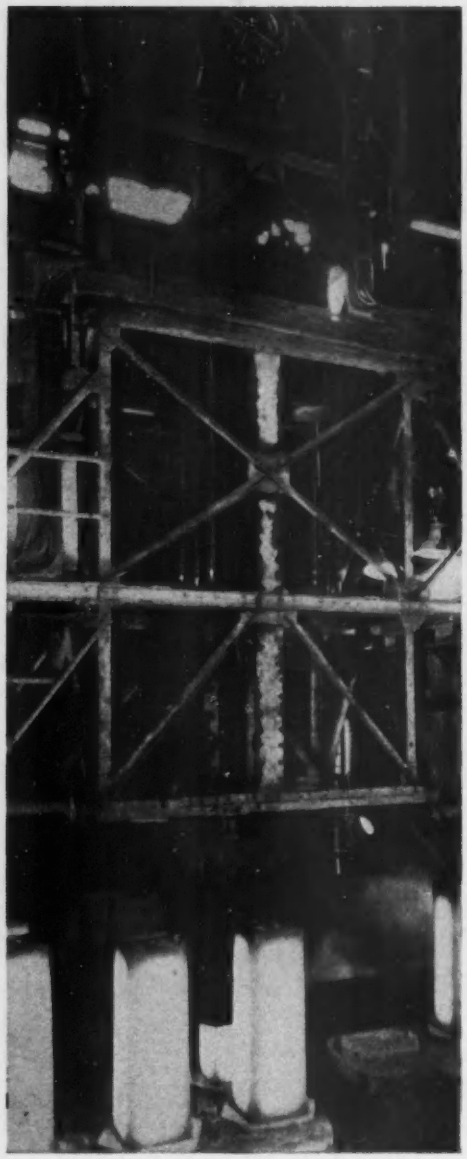
No matter how testing the working conditions, Class H motors will take the strain: you can safely subject your Class H motors to high humidity, scorching heat and heavy overloads. And it is often possible to choose a Class H motor of lower capacity than a Class A or B machine, because it is far more resistant to overload.

The advantages of Class H silicone insulation (to BS 2757) are by no means restricted to new machines. Many failing motors have been transformed into trouble-free units by a timely silicone Class H rewind.

Proved by tests: Continuous running tests have proved, that the insulation life of Class H motors outlasts both Class A and B insulation by *more than ten times.*

next time—try a Silicone Rewind

MS



CHOOSE THE MOTOR WITH H IN IT

£2,000 SAVED

with ONE Class H rewind

27 breakdowns in seven years. The cause? Insulation failure. The electric motor on a four-ton stripper crane at Workington Iron and Steel Company kept breaking down, so in 1953 the 50 hp Class A motor was replaced by a Class B insulated motor of the same rating specially designed for heavy duty—but there were still 5 insulation breakdowns over the next three years.

Because of production losses and the cost of rewinds the motor was finally rewound in 1956 with Class H insulating materials—silicones combined with glasscloth and mica..

Result? In the words of Workington Iron and Steel Company, 'No breakdowns since that date'. A saving of £2,000 in rewind costs with *no* further losses in production due to insulation failure.

These firms make Class H motors:-

Associated Electrical Industries Ltd · The English Electric Co. Ltd · The General Electric Co. Ltd · Bruce Peebles & Co. Ltd · Woods of Colchester Ltd · Brook Motors Ltd Lancashire Dynamo & Crypto Ltd · Brush Electrical Engineering Co. Ltd · Howells Electric Motors Ltd · Laurence, Scott and Electromotors Ltd.

Contact your nearest Midland Silicone area office, and ask for a list of rewinders who carry out silicone rewinds. Also ask for a copy of our news bulletin: 'MS News for Industry'.

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Class B(130°c)

FLAME RETARDANT INSULATION

at one third of the cost

of woven glass laminates

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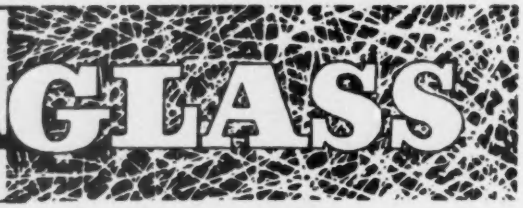

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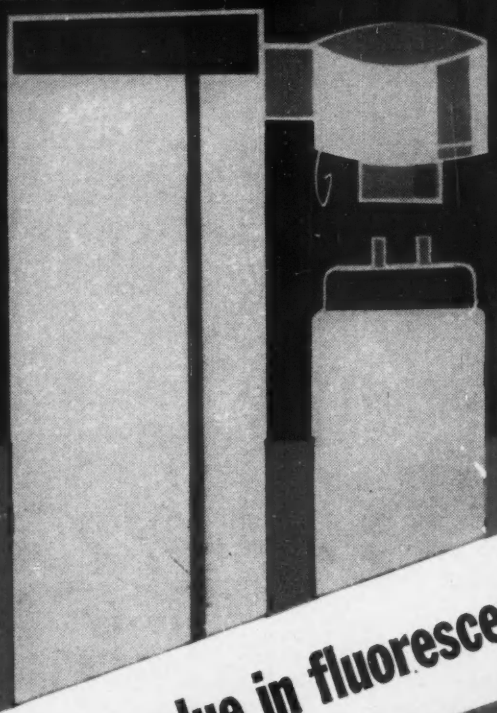

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THE GENERAL ELECTRIC CO. LTD
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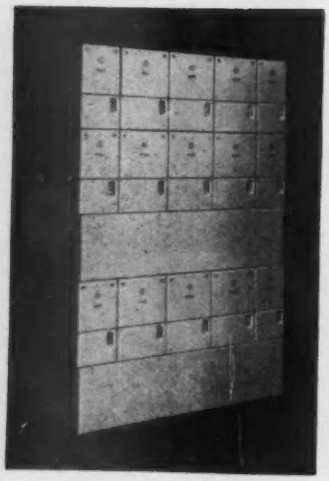
and now—

the outstanding new SANDACEE range of A.C. switch fuses



Build your switchpanels into compact space-saving units with SANDACEE A.C. Switch fuses. Smooth projection-free casing permits any form of unit assembly without spacings. Features include fully interlocked front-operated switch having heavy duty solid silver contacts and with ON/OFF indicator.

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Send for leaflet No. 162/61.

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WILLIAM SANDERS & CO. (WEDNESBURY) LTD.
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NEWS SHEET

Orders placed for 2,000 MW Eggborough station. 500 MW AEI sets will operate at 2,300 lb/sq in., 1,050°F. Five-cylinder tandem-compound turbines will have six l.p. stages exhausting to single condenser. Steam is bled after h.p. cylinder for 15,000 b.h.p. turbine driving feed pump. Foster Wheeler-John Brown Land Boilers consortium to make boilers. (929)

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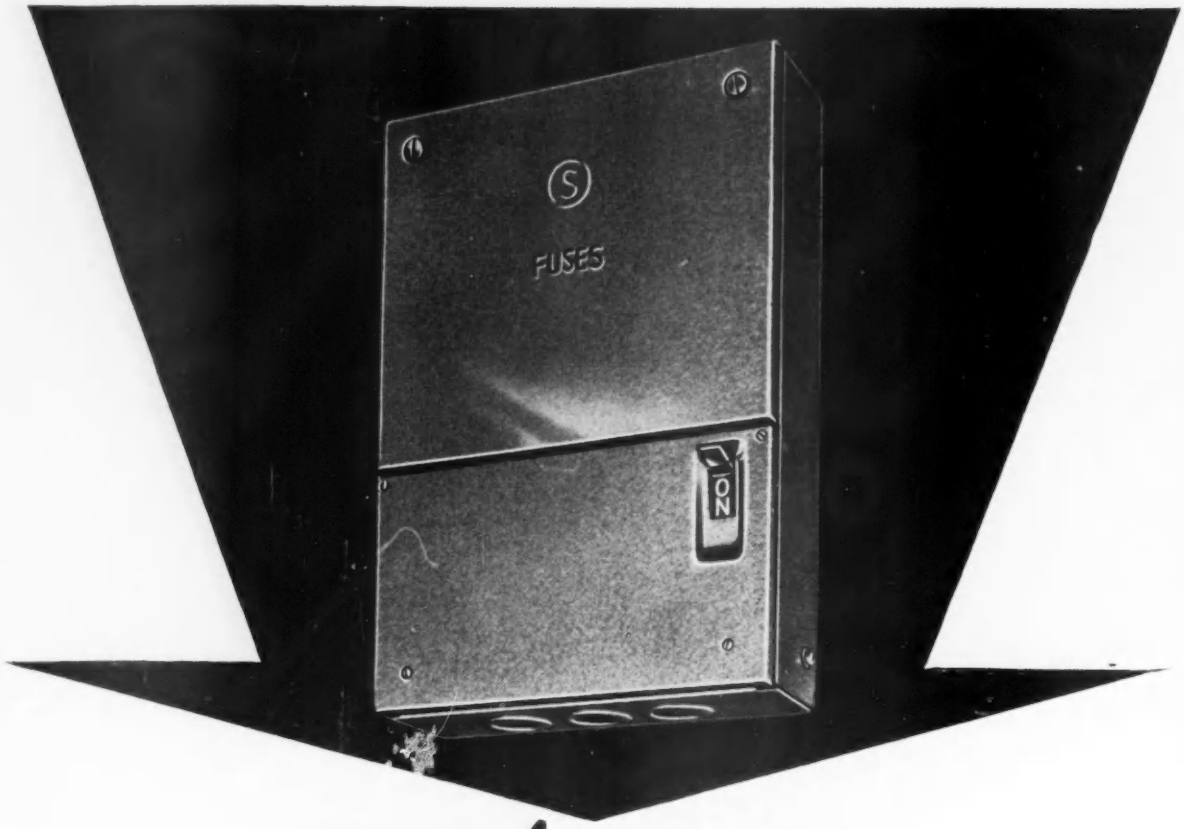

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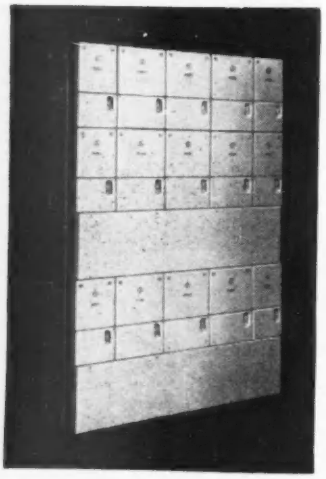

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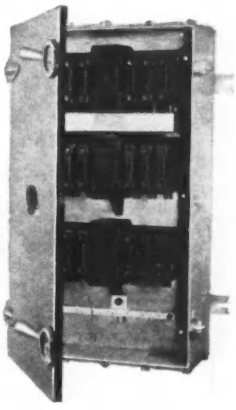
TYPE 'T' H.R.C. FUSE-LINKS
(35 MVA at 440 Volts A.C.)

'RED SPOT'
H.R.C.
FUSE FITTINGS



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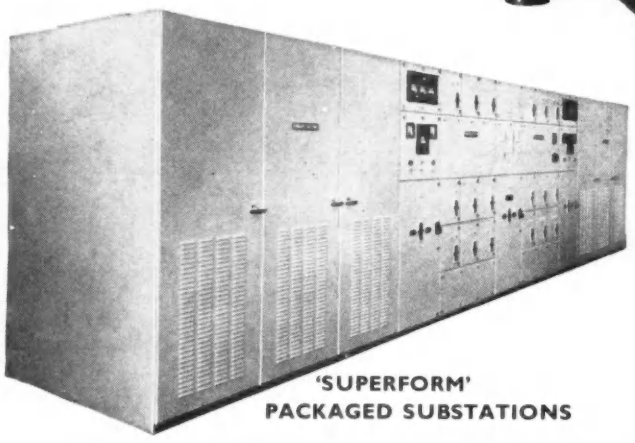

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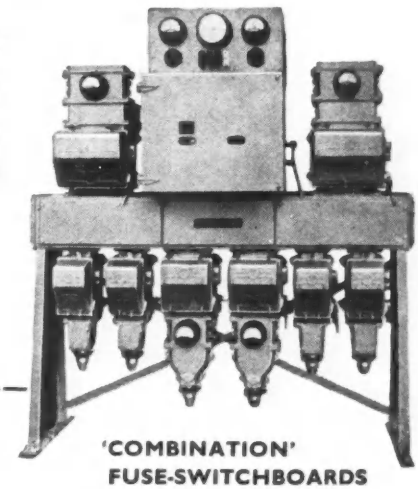

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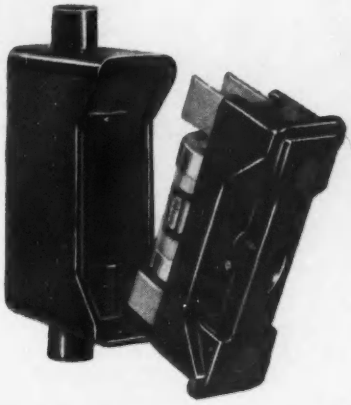
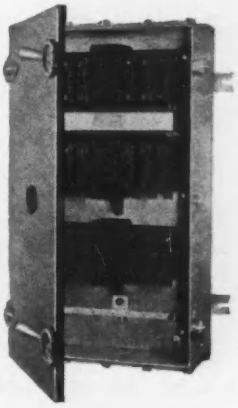
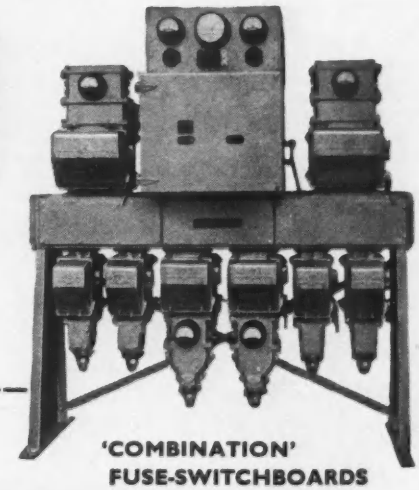
'RED SPOT' H.R.C. FUSE FITTINGS





'RED SPOT' HEAVY DUTY FUSEBOARDS

'SUPERFORM' PACKAGED SUBSTATIONS



'COMBINATION' FUSE-SWITCHBOARDS

'ENGLISH ELECTRIC' manufacture:

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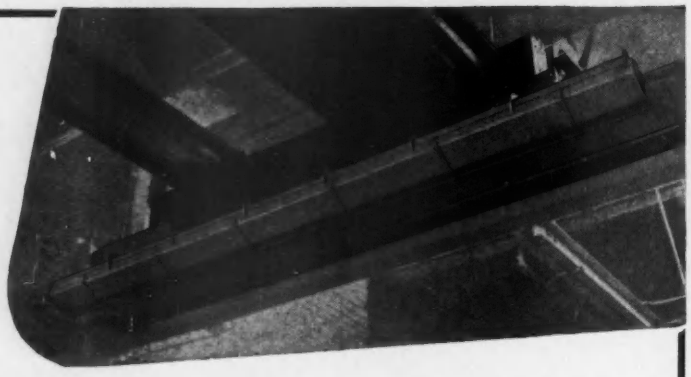
A NEW NAME MEANING COMPLETE SAFETY IN POWER SUPPLIES TO TRAVELLING CRANES



Manguard

SAFETY SUPPLY SYSTEM
Patent No. 861073

PRINCIPLE

The principle of Manguard is the provision of a set of flexible bar collectors on the crane and electrically protected contact boxes at intervals along the crane track connected by insulated cable.

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- Contact box spacing ensures an electrical supply to the crane at all times.
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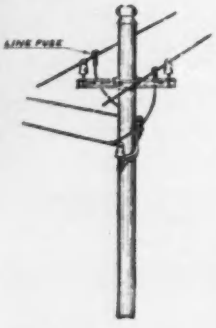
LINE FUSE CONNECTORS FOR OVERHEAD SERVICES

FUSE CONNECTOR

No. LF 176	Up to	20 amps
No. LF 211	,,	60 amps
No. LF 222	,,	100 amps
No. LF 233	,,	200 amps



This connector increases reliability, because service mains, etc., are fused where connected to main conductors, thus any fault leaves the main conductors unaffected.

SIMPLE IN DESIGN

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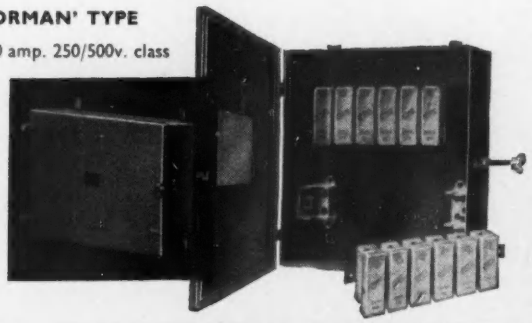
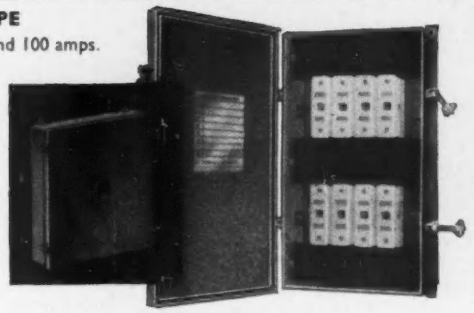
The standard finish is 'hammered' grey enamel. Where special protection is required boards can either be galvanised or treated with a special zinc spray finish.

INDUSTRIAL PATTERN

'DORMAN' TYPE
0-30 amp. 250/500v. class

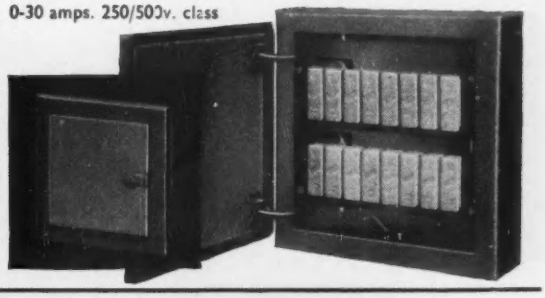


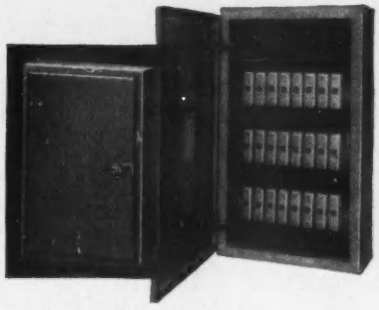
'ASC' TYPE
15/30, 60 and 100 amps.
500v. class



FLOWLINE PATTERN

'DORMAN' TYPE
0-30 amps. 250/500v. class





'ASC' TYPE
15/30, 60 and 100 amps.
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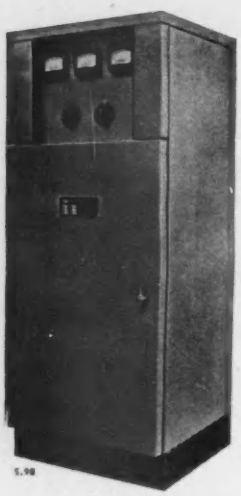

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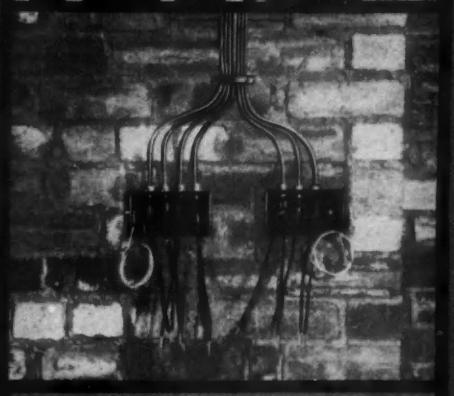

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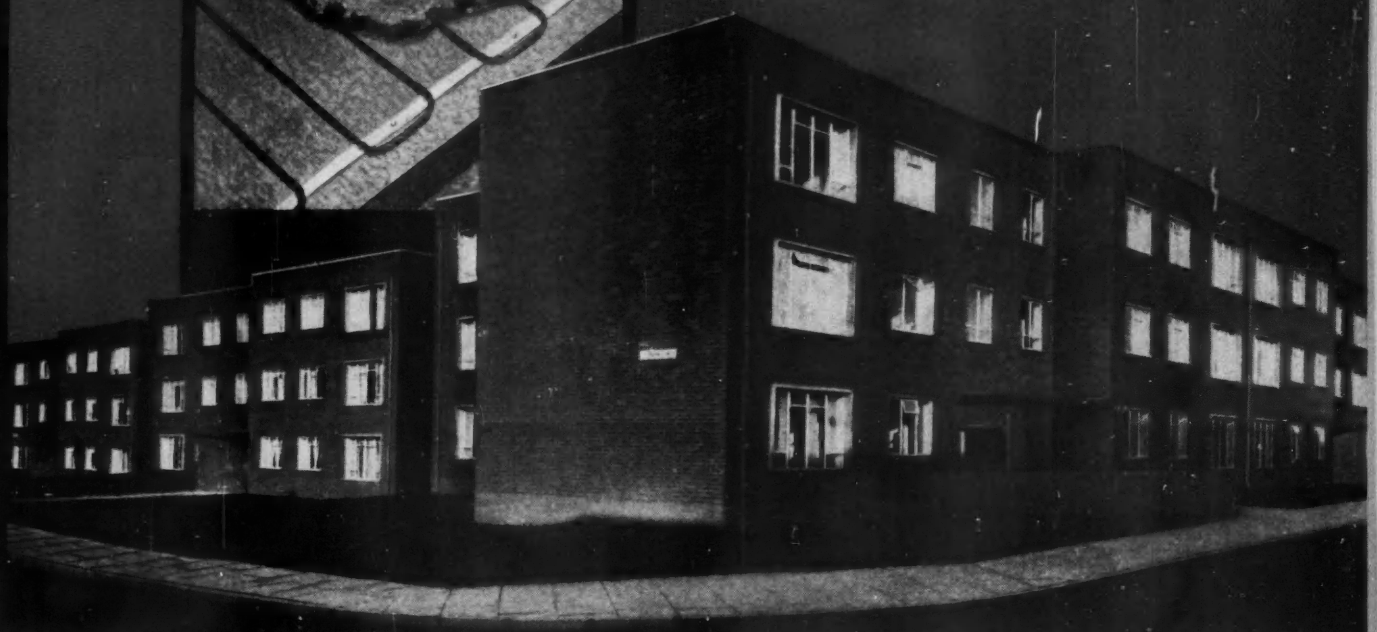

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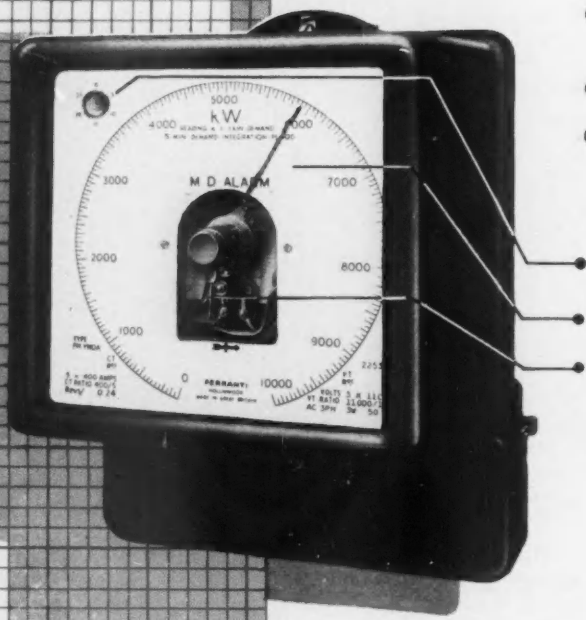

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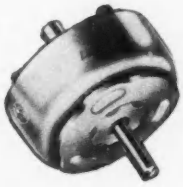

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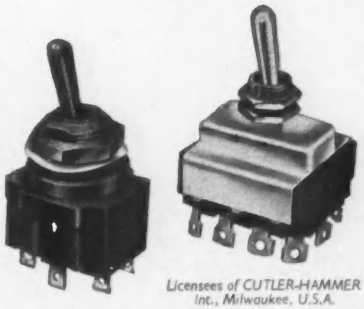

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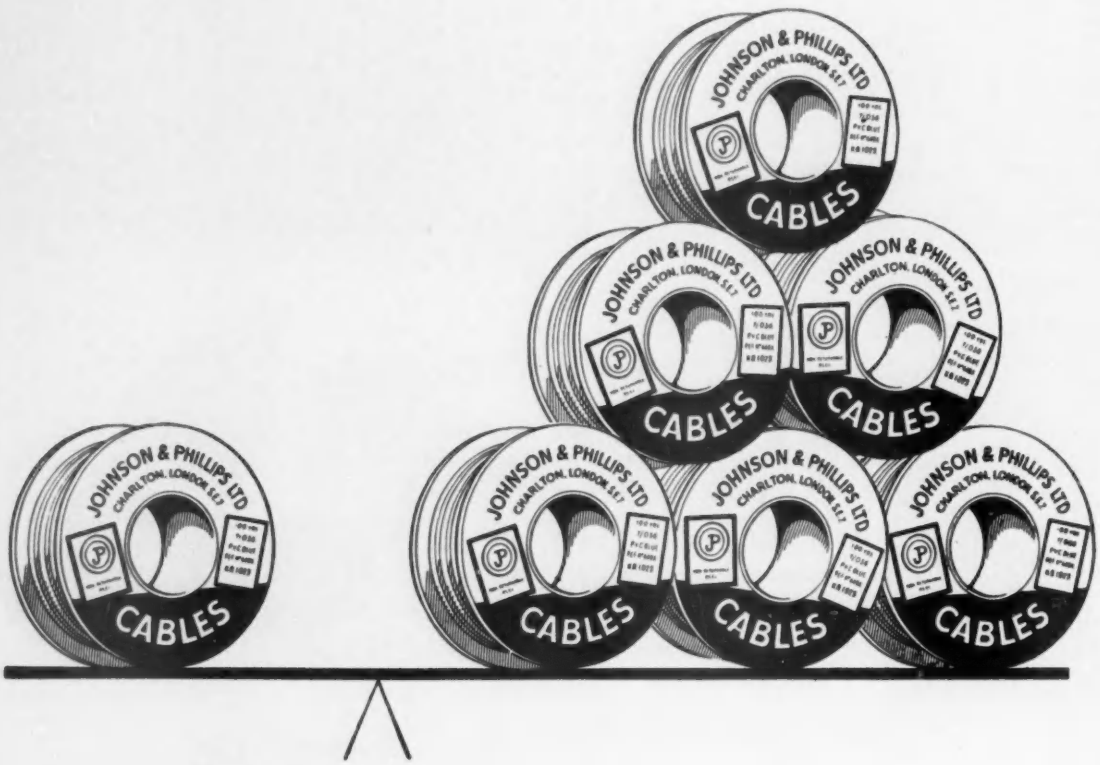

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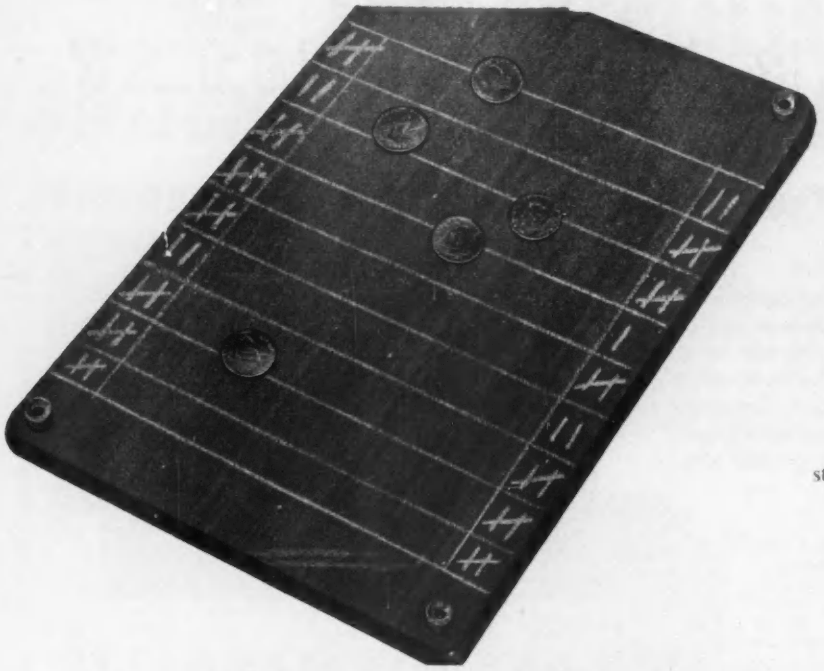

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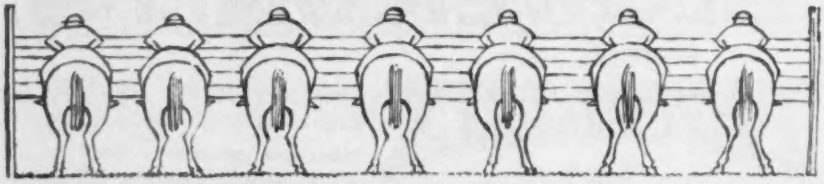
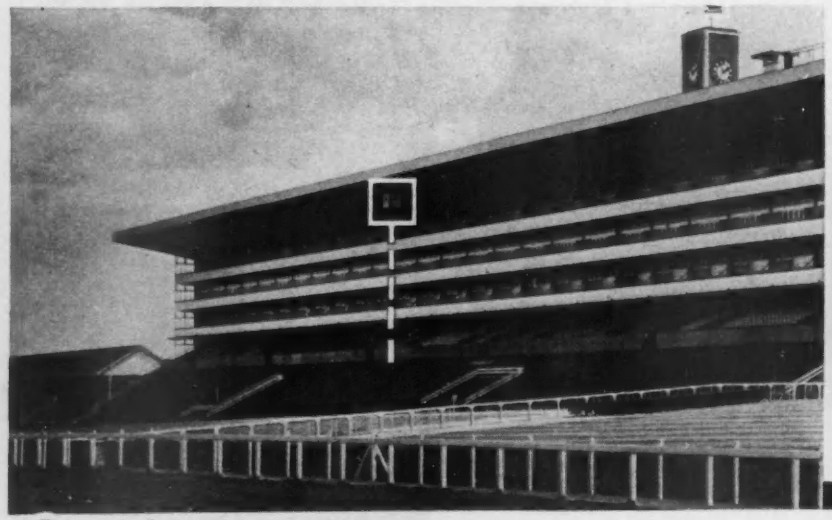
under starter's orders!



How to service the clock, weighing a quarter of a ton, 80 feet up in the new Grandstand at Ascot ? This was a problem - until L.E.F. were called in. An L.E.F. Contact Suspension Unit, to support the clock, was built into the roof of the stand. And L.E.F. produced and installed a simple combination of hand and motorised winching that raises and lowers the clock, easily and safely.

Call in L.E.F. when planning is 'under starter's orders' and the problem of maintaining highly placed objects never arises.



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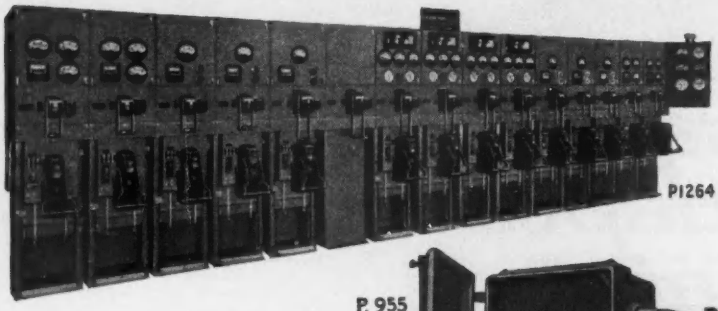
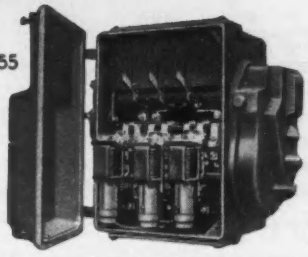
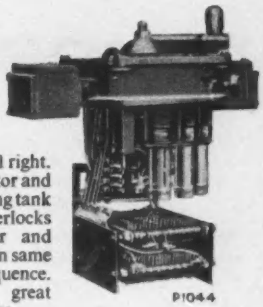

P1264

P1264 Illustrated left, Switchboard recently supplied for controlling diesel Alternator Sets and Feeders at a large Sewage Works. This Switchboard is of the duplicate busbar type and contains circuit breakers ASTA certified at 25 MVA to BS. 116 at 400 volts.

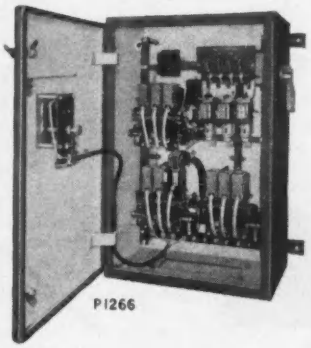

P. 955

P 955 Illustration on the right is of a hand-operated air break star delta starter, fitted with interlocked isolator and solenoid type overloads with time lags. This starter can also be supplied as a direct-on starter.


P1044

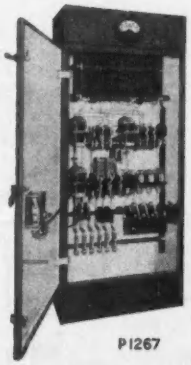
P1044 Illustrated right. Combined type stator and rotor starter showing tank removed. No interlocks required as stator and rotor contacts are on same drum in correct sequence. There is also a great saving in floor space.

CONTACTOR TYPE SWITCHGEAR & MOTOR CONTROL GEAR


P1266

P1266 Starter illustrated above is one of our CS. 30 pattern star delta starters, suitable for use up to 20 H.P. This type of starter is made in different ranges up to 250 H.P.

P1327 Illustrated right, multi motor contactor type Switchboard recently supplied for controlling air conditioning and refrigeration plant in the Middle East.


P1267

P 1327

P1267 Starter illustrated at the left is a 50 H.P. CS. 75 type stator and rotor starter. This starter is made in different ranges up to 250 H.P. All our contactors above the CS. 15 size are bar mounted with powerful magnetic blowouts.

WE MANUFACTURE :- L.T. SWITCHGEAR 50/7,000 Amperes. E.H.T. SWITCHGEAR up to 11 kV. 250 MVA rupturing capacity. MOTOR CONTROL GEAR ¼/5000 H.P.

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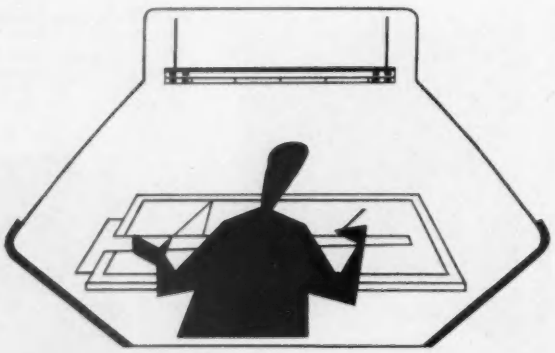

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1 kW, 2 kW, 3 kW

LENGTHS:
3 ft 3 in, 5 ft 10 in, 8 ft 6 in

3 FIXINGS:
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Screening of H.F. Apparatus in Factories 927

Supply and Distribution in Factories 928

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Fourniture d'Electricite aux Bâtiments Elevés 915
Les circuits électriques des bâtiments élevés au Royaume-Uni ont été divisés en sections verticales, chaque section étant alimentée par des barres conductrices verticales reliées à une sous-station de transformation située au sous-sol. Dans le cas de bâtiments ayant 30 étages ou plus, il peut être nécessaire d'alimenter en courant haute tension des transformateurs situés aux étages intermédiares.

Circuit Electrique pour une Centrale Nucléaire 917
Le circuit électrique auxiliaire de la centrale électrique nucléaire de Hunterston, qui est en cours de construction en Ecosse, fonctionnera à 6.6 kV. La charge acheminée par ce circuit représente environ 15% de la puissance nette produite, car les groupes de circulation du gaz utilisent des moteurs électriques. Une partie de l'alimentation auxiliaire provient de transformateurs reliés aux barres conductrices principales de la centrale; une autre partie provient de transformateurs reliés aux bornes des générateurs. Si le courant provenant d'un de ces derniers transformateurs vient à manquer, une alimentation de secours fournie par le transformateur de la centrale est mise en circuit automatiquement. Les huit groupes de circulation du gaz sont mis en oeuvre par un moteur à courant continu de 2320 Hp, alimentés par un redresseur à arc à vapeur de mercure à grille commandée.

Machine Lineaire Oscillante 933
Dans un type nouveau de générateur électrique de courant alternatif un équipage mobile se déplace en ligne droite avec un mouvement alternatif entre les deux pôles d'un ensemble à courant continu. Un voltage induit est créé dans cet équipage mobile à boucle unique qui entoure un noyau magnétique et se déplace autour de ce noyau. Le noyau comporte des bobines fixes dans lesquelles un courant alternatif est induit. Cette machine est une génératrice qui peut transformer la puissance mécanique fournie directement par un piston, en courant alternatif.

In dieser Nummer

Elektrizität für Hochbauten 915
Bei der Elektrizitätsversorgung hoher Gebäude in England teilt man die Last in Vertikalabschnitte auf, wobei jeder Abschnitt mittels vertikaler Sammelschienen versorgt wird und ein Hilfswerk mit Transformator auf Kellerniveau eingerichtet ist. Häuser mit über 30 Stockwerken können die Zufuhr von hochgespanntem Strom zu Transformatoren erforderlich machen, die in oberhalb des Erdgeschosses gelegenen Stockwerken eingerichtet sind.

Elektrizität in einem Kernkraftwerk 917
Das Hilfskraftsystem für das gegenwärtig in Schottland errichtete Hunterston Kernkraftwerk wird mit 6,6 kV arbeiten. Die auftretenden Belastungen stellen ungefähr 15% der verfügbaren Effektivleistung dar, da die Gasumlaufpumpen elektrisch betrieben werden. Ein gewisser Teil der Hilfskraft wird den mit den Sammelschienen des Hauptwerks verbundenen Transformatoren, und ein weiterer Anteil den mit den Generatorklemmen verbundenen Transformatoren entnommen. Falls die Stromzufuhr von einem der letzteren Transformatoren entfällt, wird automatisch Reservestrom vom Kraftwerktransformator eingeschaltet. Der Antrieb für jede der acht Gasumlaufpumpen wird von einem 2320 PS Gleichstrommotor geliefert, der von einem gittergesteuerten Quecksilberdampfgleichrichter gespeist wird.

Geradschwingmaschine 933
In einem neuartigen Wechselstromgenerator wird ein bewegliches Glied innerhalb einer Gleichstrompolanordnung geradlinig hin und her geführt. Eine induzierte Spannung tritt in diesem eine einzige Schleife enthaltenden beweglichen Glied auf, das einen Magnetkern umschliesst und sich an ihm entlangbewegt. Der Kern ist mit feststehenden Spulen versehen, in die ein Wechselstrom induziert wird. Eine derartige Maschine kann als Generator Verwendung finden, wenn die von einem Kolben gelieferte mechanische Kraft direkt in elektrischen Strom umgewandelt werden soll.

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SOME INSIDE INFORMATION ON.....

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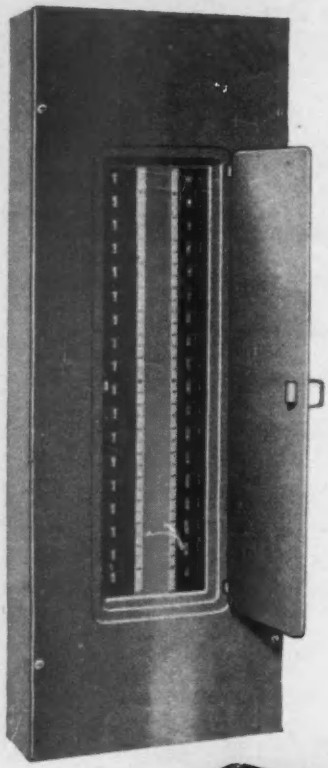

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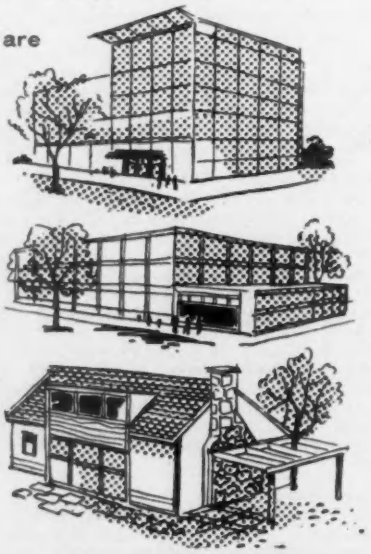

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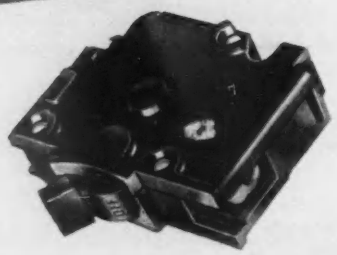

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ELECTRICAL TIMES

ESTABLISHED 1891

THURSDAY, 21 DECEMBER, 1961

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Comment

We wish our readers a Merry Christmas and a Happy New Year

I.E.E. PATTERN

IEE members have the opportunity over Christmas of considering with which "professional groups" they should associate themselves. The new organisation of the Institution provides that after next October three divisions, split into 18 groups of more detailed interests, shall handle the "learned society" activities of the IEE. The list of groups is reproduced elsewhere in this issue. There are some imaginative provisions in it and some surprising omissions. On the whole, the activities of the present supply and electronics and communications sections will be well provided for in the new set-up. Measurements and control section interests are fragmented between the divisions in a way likely to cause some problems; and the utilisation section interests are seriously afflicted. Many members of the Institution are likely to think that the greatest shortcoming of the new organisation is the absence of any group concerned with installation work in the broadest sense (including that oldest of electrical power interests, illumination). The one that can be claimed as most interested is the negatively titled "non-industrial applications" group. This seems entirely wrong for an Institution which is responsible for the country's wiring code. On the other hand, the establishment of groups to look after such matters as novel methods of generation and the properties and testing of material is likely to be both welcome to members and advantageous to the industry. The Institution has stated that there is no suggestion of finality to be attached to the present list of groups. Improvement in the light of experience may be hoped for.

MORE FROM CONSUMERS

The consumer is having to supply an ever-larger part of the finance for expansion of the supply industry. There have been plenty of warnings of late that the screw is going to be turned tighter, but the figures given by the Minister of Power in persuading the House of Commons to increase the supply industry's borrowing powers still impress. Over the five years 1962-63 to 1966-67, the boards in England and Wales have to earn aggregate surpluses of £325 million. Half of that total will come from the CEGB through the operation of the bulk supply tariff; the rest from the boards. These totals (£65 million a year average) have to be thought of in terms of aggregate industry costs, currently running at about £600 million when interest and depreciation charges are included. Mr Wood estimates that such

surpluses represent a net return on assets of about 7% after charging depreciation. How much electrical manufacturers and CEGB development engineers are doing to keep down costs to consumers is illustrated by another figure he gave. Station cost/kW installed, which stood at £53 in 1958 and is currently £40, should fall as low as £35 by the late 1960s—for conventional plant. How nuclear will compare depends in part on the cost of money and the cost of coal seven years ahead. Sir Christopher Hinton last week again warned that the cost of nuclear power seems certain to stay high, and that stations advanced in nuclear design may be slow to come into CEGB use.

RESEARCH PICTURE

The report on the Federation of British Industry's thorough-going survey of research and development in member firms leads to a number of broad conclusions that confirm those reached by other authorities. Manpower shortage is the main limitation on expanding research and development activities, and research is overwhelmingly concentrated in the larger firms. A new statistic, however, and one that deserves further study, is a breakdown of research and development activity between basic research, product development, development of new products, and general technical services. For industry as a whole, excluding the rather special case of the aircraft industry, nearly 10% of work is estimated to be concerned with basic research; and 35% and 37%, respectively, on improvements of existing products and development of new products. For electrical engineering, the proportion of basic research is about the same, at over 9%, but the forward-looking character of the industry stands out, with 22% of the work directed to improving existing products and 42% on new products. The surprising figure is the 9% for basic research. It is higher than many previous commentators had expected. The division is arbitrary, for no definition of "basic research" was offered in the questionnaire on which the survey is based. Such research expenditure has to be compared with that of the industry on research by outside bodies, such as universities and research associations, which might expect to carry out the majority of the basic research. External spending of this sort amounts to less than 2% of internal research and development expenditure. There is an implication here that individual firms may be undertaking an amount of basic research that is uneconomic, since work may be in hand on a given problem in several firms, whereas co-operation might help everyone, given the overall shortage of manpower.

NUCLEAR COMPLEXITY

One of the advantages claimed for the gas-cooled natural uranium graphite-moderated nuclear reactor for power production is that it represents a relatively small step from conventional engineering compared with its rivals. How much complication accompanies even that advance was well illustrated at an IEE meeting last week. The subject was the electrical—the non-nuclear—features of the Hunterston nuclear generation station. Throughout the consideration of the equipment for supplying auxiliaries and for matching the station output to system demands, the pervading influence of nuclear considerations is apparent. Principally, this is a matter of safety. An extreme view of the need to ensure that none of the supplies essential to reactor safety is lost, means that duplication of supplies and interlocking is carried to a far greater length than in a conventional station. It is a valid query, voiced more than once in the discussion on the paper, whether this sort of complexity may not involve the acceptance of a large number of faults, each sufficient to cause inconvenience. Such a situation may be the price that has to be paid for having a vanishing small number of faults that might cause failure to danger. The ingenious arrangement for automatic switching-in of stand-by circuits without waiting for motors to stop before they are energised from the secondary source is an example of the originality to which the designers of nuclear stations are driven. This "quick-switch" technique has not been used before in British power stations, though it has operated satisfactorily in chemical and oil installations.

WATCH THE PLUGS

Forty-nine people lost their lives in electrical accidents in and about the home during 1960. As accident totals go, that is small. Yet the impression left by the Home Office electrical adviser's summary of the circumstances of the accidents is the needlessness of most of them. Although the causes are widespread, there are some relatively simple precautions that could cut the total deaths in half. Two are outstanding: avoidance of switches in neutral wires, and care in wiring plugs. Of the two, a switch in the neutral is perhaps the more insidious, and it is a fault that only the trained electrician is likely to avoid or to spot once it has occurred. Plugs are a different matter. They will usually be wired by the owners of appliances; that simple fact has to be faced. The propaganda of the industry and the care taken by most manufacturers in labelling plugs is gradually getting over the idea of how to distinguish and connect the three pins and the three cores of the usual flexible. Where there are two-pin plugs, however, the third core is an embarrassment that caused at least one death last year. Perhaps appliance manufacturers ought to attach some advice on this point to their unterminated flexibles. Universal acceptance of the 13 A BS socket would, of course, solve the problem. It would help as well in avoiding the accident that arises when a lead comes loose in the plug. Highly effective as well would be persuasion of appliance users everywhere to take out the plug when an appliance is out of use—for time in which there is risk of an accident is important to electrical accident totals as to most others.

Meteor

This week's quick summary of electrical news faces advertisement page 8

Electrical Times, 21 December, 1961

Distribution in high buildings

by G. Davidson, M.I.E.E.*

Exemplifying London's high buildings is this development with a 20-storey tower and a frontage on Oxford St. Power comes from five 500 kVA basement transformer substations, three of which are for the tower load

DEVELOPMENT of "skyscraper" building construction in this country has necessitated fresh thought being given to distributing electricity within these buildings. The simple problem is like placing two or three conventional eight-storey to ten-storey buildings above one another and trying to combine their electrical demands and supply facilities; but recent trends make it more complicated than this.

Economic investigation of methods for carrying heavy-load current vertically upward is an urgent necessity and, while it is not intended in this article to deal with this problem except to draw attention to the needs of high buildings, it is fairly safe to say that high-voltage feeders and transformer substations at various levels will be the ultimate solution adopted.

Consider the trends in utilising electricity in office buildings and the effect of height on the services required. In the order of heaviest power units the requirements are for air-conditioning compressors, lift motors, ventilating fans and heating plant pumps. Many buildings also need sewage and drainage pumps as well as booster pumps for fire fighting. However, lighting and office machinery *in toto* make up the main bulk of the electricity load. If kitchens for staff catering with electric cooking equipment are included, this load will be considerable. But, at present, gas appears to be the favoured fuel for cooking and electrical drives in the kitchen take comparatively little power. All services are affected to some degree by the height of the building, and some of them are affected by the rising standards in occupational conditions.

Electrical Services

Air-conditioning is being increasingly introduced to office buildings. It may consist of a small plant for a director's suite or a large plant for the whole of the building and requiring as much power as all other electrical services. It is usual for the refrigerating plant, with its high-power compressors, to be situated at the lowest basement level, while ventilating plant is placed on the roof. But very high buildings of the future may need plant rooms on intermediate levels in order to conform economically with the building requirements, because the limitations of friction losses in air ducts and permissible water pressure drops in pipe-lines pose problems to the mechanical engineer even greater than those the electrical engineer must solve when space is at a premium.

Lift motor rooms may be at different levels in very tall buildings because a good lift service usually requires high-speed lifts for the upper floors. So that the low-speed lift motor room might be on the tenth or twelfth floor in a 20-storey building. Taller buildings may require a three-zone lift service for 30 storeys or four-zone for 50 storeys, with speeds from 300 f.p.m. or 500 f.p.m. in the lowest zone, to 1,200 f.p.m. in the highest zone. Even though higher floors may have smaller areas than the lower floors and may need smaller cars, on the whole the higher zone lifts will require much more power than those in the lower zones, and a large proportion of power will be required towards the top of the building.

The building height directly affects the power cabling for ventilation plant and lifts, which is, as a rule, separate from tenants' rising mains, since the problems of voltage drop become greater as building height increases. But if sufficient power is required, transformer substations near the load concentrations may be the best solution and these intermediate levels, determined by lift and ventilation service requirements, would also be suitable levels for transformer substations.

The new lighting code introduced this year raises the standard of amenity lighting from 7 lm/sq ft to 15 lm/sq ft; for office work from 20 lm/sq ft to 30 lm/sq ft, and to 45 lm/sq ft for business machine operation; in drawing offices from 15 lm/sq ft to 30 lm/sq ft for general lighting, and from 30 lm/sq ft to 45 lm/sq ft on boards; while private office illumination is raised from 15 lm/sq ft to 30 lm/sq ft. There is also a high probability that the new principle of permanent supplementary artificial lighting of interiors will be adopted, which will increase illumination in the darker areas of rooms to higher values than normal design intensities to reduce contrast with daylight from the windows. This will also increase the normal lighting load and it can be seen that lighting loads will be at least doubled in the immediate future.

Computers are now being increasingly employed in large organisations and may form a major addition to the electricity load. Even if they are transistorised, the computer rooms are usually air-conditioned, but if thermionic valves are used in the computer, air-conditioning equipment needs to be very much larger and a single computer may require between 15 kW and 150 kW or more, including air-conditioning plant necessary.

Another formidable load being increasingly adopted is, of course, electric floor-warming. However, this is generally designed as an off-peak system. The installation will probably have separate distribution mains and its demand will not coincide with that of the main load so

* Mr Davidson is electrical consultant to T. P. Bennett and Son, architects.

far as the normal rising mains are concerned. But if a midday boost is necessary it will add to the loads previously mentioned to be borne by the supply authority's transformer substations feeding the building. Rising mains intended to provide floor-heating supplies as well as other services to a number of tenants must therefore be subject to careful consideration from this point of view.

The old basis of load assessment of, say, 1½ W/sq ft or 2 W/sq ft of floor area has already gone by the board and building loads are being increased, not only by skyscraper construction, but also by modern trends in utilisation, which are parallel and cumulative in effect. It does not need a great stretch of imagination to appreciate that we shall be faced in the immediate future with distribution problems in single buildings involving loads which may be six times to nine times the loads to which we have been accustomed in the past; not spread out horizontally on a site, but vertically up the building.

The electrical load of a large office block often requires the whole output of a supply authority's substation. Two or more may even be required for a very large project covering a considerable area; and space has to be provided for them, usually in the basement. A common transformer capacity in such substations is 500 kVA and electricity board engineers try to disperse them as widely apart as possible to ensure security of supply, both to the building owner and to neighbouring consumers, because although a substation may be installed in a building for the electrical requirements of that particular building, it is interconnected with neighbouring substations to ensure continuity of supply should a transformer fail.

The present tendency is to deal with the greater loads by serving each riser from a separate substation situated near its base instead of running radial horizontal feeders from a single substation to the various risers in the building. This arrangement generally meets the need without taking high-voltage risers to higher-level transformer substations, and has proved suitable for buildings up to about 20 floors. It has been found expedient to divide the building load into vertical sections equivalent to substation capacities with a substation as near to the base of the section riser as possible.

High Level Transformers

The next development, as load increases and the architect restricts valuable letting area required for the accommodation of substations and risers, must be to place small transformers at higher levels. Weight will then be a major consideration and dry-type, air-cooled transformers will probably be chosen. An attractive method would be to employ one transformer/floor, accommodated in riser cupboards of generous dimensions, and to parallel a number of transformers on the riser feeding them. A primary voltage of 3·3 kV or 6·6 kV would be suitable for many cases as these are standard switchgear voltages and the more common 11 kV of the electricity boards' systems might be considered; but this requires clearances which might not be afforded inside a building, so lower standard distribution voltages may come into vogue for high buildings. Kelvin's Law might be adapted to equate costs, not only of copper and energy but also of the transformers and of the floor areas they would occupy.

The obvious question that arises is: should the building owner install his own distribution system or should the supply authority be responsible for supplies to terminal points at various levels in the building? Where a single occupier is involved the former is probably the answer, but with multi-occupier premises—and there is no certainty that any large building will not change at any time from one to the other—the supply authority must control the rising mains and his supply point must be on each consumer's premises at various levels. It is not uncommon for electricity boards to install, at their own expense, rising mains in council flats, provided the flats are adequately wired for outlets so that they will be likely to provide revenue that will justify the installation expense. A similar arrangement has been considered for private enterprise projects. The precedent exists, therefore, to support the suggestion that h.v. cables to substations at high levels in a tall building might well be the responsibility of the supply authority. Furthermore, the electricity boards are far better equipped with staff, experience and skill to handle high-voltage cabling and equipment than are most electrical contractors.

Distribution economics for high buildings has not yet received particular attention by the installation industry because so far building trends have not been very clear. Techniques have advanced to the extent that buildings of twice the height and number of storeys that were normal in the past can be safely constructed on the same ground, and a limited number of such buildings have been completed or are under construction. But there are insufficient to have established new methods of electricity distribution within them. There are several buildings of up to 20 storeys but extremely few in this country which are higher. Although the installation problem becomes much greater above this height, the utilisation aspect makes it also important for buildings between 12 storeys and 20 storeys high. But we are not certain yet to what extent the tall building will be successful in this country, how many more will be built, or how high they will be.

Experience in America

About seven years ago, when the load in the Empire State building had increased to 25·8 MVA—about three times the original load—it was decided to provide all new buildings requiring over 2 MVA with 460/265 V distribution instead of the 208/120 V previously supplied from the transformer secondaries feeding the building.

In the United Nations Secretariat building, which has 39 storeys and is 500 ft high, 1 MVA transformer substations are provided at the twenty-eighth floor as well as in the first basement, and these are fed with 13·2 kV feeders. The 42-storey Socony Mobil building has substations with transformers having ratios of 460 V/208 V on the ground, tenth, twentieth and thirty-first floor levels, and these are fed at 460 V from 2 MVA transformer banks at street level; the supply voltage to the transformers being 13·2 kV and 69 kV. The final subcircuit voltage in these buildings is, of course, 208/120 V. The design loading assessment was 4 W/sq ft for a lighting intensity of 50 lm/sq ft and 2 W/sq ft for socket-outlet purposes, apart from power for heating, ventilating and air-conditioning plant. Reactors in the h.v. feeders are also used to limit short-circuit currents.

Currents are enormous at these low internal distribution voltages and they make values common in this country look trifling by comparison, but electricity utilisation in office buildings in this country is rapidly approaching the standard common in America and, while our higher voltages reduce the seriousness of the problem facing us here, a lesson can be learnt by noting what was done across the Atlantic for similar developments.

It may be sufficient for the present, however, to realise the extent of the immediate needs in high buildings now being constructed and to satisfy these in such a way that the sound economic methods used can be easily applied to higher buildings that may be built in the future.

Hunterston's electrical system

GOVERNOR AND AUXILIARY SUPPLY FEATURES

COMPLETE reliability of the auxiliaries supply system and the importance of maintaining reactor power as constant as possible are two requirements which influence nuclear station design.

In a paper* presented to the IEE last Wednesday, some aspects of the Hunterston station were described. This station will have two graphite-moderated, gas-cooled reactors, giving a net electrical output of 300 MW. The six 60 MW turbo-alternators will receive steam from the eight reactor heat exchangers under two conditions: 578 lb/sq in., 385°C and 147 lb/sq in., 363°C. The station will be connected to the SSEB 275 kV system, which is at present operating at 132 kV, and an eventual load factor of 80% is hoped for when the 400 MW pumped-storage scheme at Ben Cruachan is brought into service in 1965-66.

Control of Output

Hunterston nuclear station is intended to supply a large part of the SSEB night load in conjunction with power received from Chapelcross. The Chapelcross and Calder Hall control systems are designed to maintain the reactors at a fixed thermal output and they rely on keeping the steam pressure before the turbine throttle valve at a constant value. If a similar control scheme was used for Hunterston, the frequency stability of the SSEB network would rely on a few lightly loaded conventional stations. The Hunterston control system therefore incorporates turbine speed control, but it is also designed to restrict rapid fluctuations in electrical demand being transferred to the reactors. Large-capacity buffer steam drums included in the h.p. and l.p. steam system which can meet short-term changes in electrical demand also help to keep reactor power nearly constant. Whether reactor power can be varied to compensate for frequency changes depends on several reactor design factors. For example, the rate at which the reactor can follow a change in system demand is determined by the rate of change of coolant flow. This is limited to 3%/min since, if a fault occurred which reduced the rate of coolant flow without reducing reactor power, a higher rate of change could cause the fuel elements to overheat.

Each reactor and its three associated generators are controlled as a unit. Two independent systems are used: coolant outlet temperature is controlled by movement of the reactor control rods and speed variation of the gas circulators determines the pressure of the h.p. steam.

The turbines have a pressure-sensitive control for h.p. and l.p. systems which closes the appropriate throttle valves on a fall of steam pressure, and also a speed-sensitive regulator common to h.p. and l.p. valves which close the valves if the set speed increases.

When the governor system is being used to maintain constant frequency, the h.p. steam flow is regulated by the speed governor and the pressure governor is not used. However, l.p. steam flow will be pressure-governed to maintain control over the coolant gas inlet temperature. If turbine output required falls to about 50% full load, speed governing also takes over from pressure-governing on the l.p. system. The governor system will throw off full load for a 4% frequency change, but the rate of load reduction at full load is only about one-quarter the

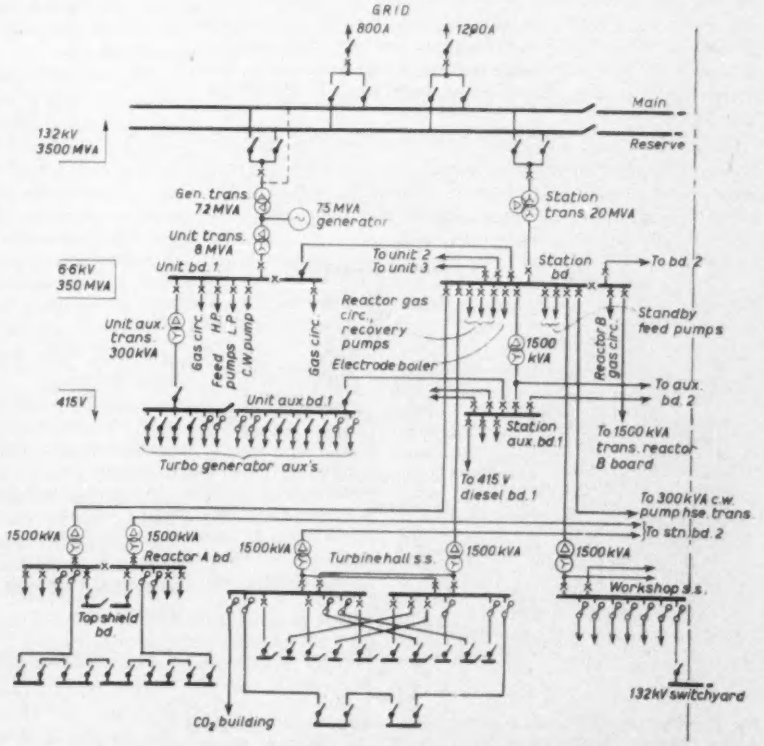


Fig. 1. The Hunterston main electrical system for reactor A only, and with only one unit board indicated. Reactor B system is similar, except for certain 415 V auxiliaries

*Paper 3770: "Electrical Aspects of Hunterston Nuclear Generating Station." by J. Henderson, M.I.E.E. (formerly with the SSEB); G. F. Kennedy, M.A., M.I.C.E., M.I.MECH.E., M.I.E.E. (Kennedy and Donkin); K. J. Wootton, B.SC., PH.D., M.I.MECH E. (GEC).

average rate. Small changes in system frequency do not, therefore, result in large changes in reactor power near full load.

Pressure in the h.p. steam receiver is kept constant by a transducer regulator which controls gas circulator speed. The pressure signal is modified by two signals, one proportional to rate of change of pressure and the other dependent on the time for which the pressure error has persisted. If the pressure difference exceeds about 15 lb/sq in., a more rapid change in circulator speed is caused by a second, high-gain, controller.

The reactor control system maintains constant power in each of eight radial sectors of the core and also maintains constant temperature for a change in coolant flow.

Computer studies have shown that for a step system frequency increase of 0·1 c/s, a sharp rise in steam pressure of about 10 lb/sq in. occurs in 1 min to 1½ min. This is quickly corrected by increased coolant flow and reactor power equilibrium is attained in 10 min to 15 min.

Main Distribution System

The total electrical auxiliary load at Hunterston, principally because the gas circulators are electrically driven, amounts to 15% of the net output, and this had an influence on the design of the 6·6 kV auxiliary system.

To ensure complete reliability, alternative emergency power is obtained from a battery of accumulators backed by automatically started diesel alternators. The 240 V batteries will carry essential auxiliaries for 20 min before the voltage drops to 200 V. The most important of these essential auxiliaries are a pair of circulators for each reactor, the stabilised supply for instruments and safety circuits provided by motor alternator sets, and various auxiliary pumps.

The main electrical distribution system is similar for the two reactors, and Fig. 1 shows the arrangement for one reactor. There are two station boards, fed from 20 MVA, 132/6·6 kV transformers, and six unit boards, fed from 8 MVA transformers directly coupled to the alternator terminals. The 6·6 kV fault level is limited to 350 MVA.

Each station and unit board is divided into two sections. There are interconnectors, which are normally open, between station board sections connected to station transformers and those sections which are not; and also between the station board and those unit board sections not connected to unit transformers.

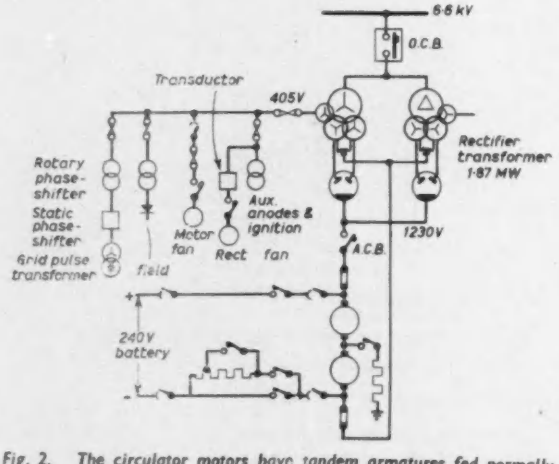


Fig. 2. The circulator motors have tandem armatures fed normally from a 12-phase mercury arc rectifier, but with an alternative emergency battery supply able to give 1/10 top speed

Continuity of supply is ensured by a quick-switching scheme. If supply fails from a unit transformer, a supply from a station board is automatically switched in after a time delay. This system has been previously used in oil refineries, but it is believed to be the first application in a British power station. Before the quick-switching scheme will operate, it is necessary that the transformer switch shall have opened and the unit board busbar voltage dropped to 25%. This residual voltage is produced by the slowing down of connected induction motors, and switching in at so low a voltage minimises electro-mechanical shock to the motors.

The unit transformer c.b .will be tripped by the protective system if a fault occurs on a generator, generator transformer, unit transformer or associated connections or on a turbine. The station board interconnector c.b. will then close and restore supply to the unit board. The unit transformer l.v. c.b. and unit board busbar section c.b. will trip if there is a fault on the busbars of the unit board section to which the unit c.b. is connected. The unit board busbar section c.b. will trip if a busbar fault occurs on the section of the unit board to which the station board interconnector is connected.

Normally, 132 kV and 6·6 kV busbar section switches would be closed and the station board interconnector would be open. Except for the circulator drives, the system is then divided in half and normally there would be no interconnection between halves at the 415 V level.

Conventional arrangement of the 415 V switchgear has been used with a maximum fault level of 25 MVA. However, supplies are duplicated and two-out-of-three interlocking is used.

The 11·8 kV alternator star points, and those of unit and station transformers are resistance-earthed to reduce earth fault currents. Special attention has been paid to terminal box design, supply cables being directly connected to the motor winding leads to reduce possibilities of explosions.

The auxiliary supply system used provides that, during normal running, most of the auxiliary load is fed from the unit transformers. If an alternator is out of service, they are transferred to the station transformers.

If a unit transformer c.b. opens, an alternative supply is automatically provided for the unit board from the station board so that vital auxiliaries are kept running. A 132 kV busbar fault will cause the section switch and all other switches connected to the faulted section to open. One reactor would therefore be disconnected from the 132 kV system, but its auxiliaries, with the exception of one circulator, remain connected to the alternator terminals. One circulator would also be lost from the other reactor.

A fault on any section of the 6·6 kV busbars removes one circulator, but the remaining seven automatically accelerate and full reactor output can be maintained if necessary for 2 hr. If three turbo-alternators are lost simultaneously with transfer of three unit boards to the station board, the station board can continue to supply the auxiliaries while the reactor power is reduced and the reactor need not be tripped. These are some of the advantages offered by the interconnection system used for Hunterston.

Gas Circulators

Each reactor has eight gas circulators driven by tandem-armature d.c. motors rated 2,354 h.p. at 1,000 r.p.m. The motors can develop 2,945 h.p. for 2 hr under emergency conditions. Brush changing has been given particular

attention and it is claimed that each brush change can be completed in 10 min on load, using a special tool, and that brush life is estimated at three months.

The motors are energised from two mercury-arc rectifiers, as shown in Fig. 2, through a single-pole, high-speed circuit-breaker. The speed of the motors is determined by grid-control of the rectifier firing angle, the grid pulses being obtained from a motor-driven induction regulator in cascade with a static-phase shifter. This latter is transductor-controlled and gives overriding control to limit the motor current under abnormal conditions; for example, during acceleration or through a fall in voltage on the 6·6 kV system. Field weakening is also provided on the motors to enable them to run overspeed.

As shown in Fig. 2, the motors can be supplied from 240 V battery bars, for slow-speed running, or in an emergency. A resistance is left in the armature circuit to adjust the speed, but also to limit the back-feed from the armature in the event of a fault on the d.c. system.

In concluding their paper, the authors refer to the indoor 132 kV substation which has been built to overcome pollution problems. The substation has reduced-phase clearances. Finally, they outline briefly the proposed reactor start-up sequence.

DISCUSSION

MR H. H. GOTT (CEGB) said that the early nuclear stations had turned out to be much more complicated than many of those concerned had expected. It was necessary to look closely at how much of the complication was justified. He instanced the provision of xenon override at Hunterston. He thought that economically it was worth while giving sufficient override to deal with a little more than the trip of one turbine, but beyond that provision of xenon override was not worth while. He queried whether it was worth while providing for part-load running of the station. In the course of further remarks Mr Gott commented that it had always been accepted that fuel elements needed to be treated with respect so far as thermal cycling was concerned. However, he felt that the evidence to show that this was necessary was rather uncertain.

MR T. H. MORRISON (Merz and McLellan) described some of the difficulties in providing lighting for the cooling ponds, where irradiated fuel elements had to be stored. The job was carried out manually and illumination was necessary for the operators to see. Little could be done with lighting placed above the water. When a lamp was lowered into comparatively pure water, the illumination at 10 ft depth was cut to 1/30th of that at the surface, at 20 ft to 1/2,400th and at 27 ft the illumination was 1/20,000th. The solution adopted was to use an inverted lamp and work on the idea of the fuel elements being seen in silhouette.

MR P. T. FLETCHER (United Power Co.) returned to the subject of complication of design. He said this increased due to modifications during building a station. He thought a good deal more experience was needed before it was possible to feel certain about operation at load factor as high as 80%; 75% might be better. Further study of the relationship between pumped storage and nuclear schemes was justified. A 10% saving in overall generating costs over the lifetime of the power station should be possible by raising load factor from 75% to 85%. He thought the quick-switch stand-by arrangement used in the auxiliary system at Hunterston was versatile but it was undeniably complicated. He questioned whether it would have been used had there been eight turbines instead of six.

MR R. D. TROTTER (CEGB) thought it was illusory to imagine that a nuclear power station would assist maintenance of system stability. He doubted whether the risk to reactor safety by having a high rate of change of gas circulator speed was worth while. He thought the use of the quick-switch auxiliary arrangement a bold decision. Overall, he thought that efficiency of operation at half load had to come far behind security of operation at full load. The selection of d.c. motors did not seem a good one from the maximum security aspect.

MR D. A. DEWISON (CEGB) said that the quick-switch had been considered for other power stations but not used. This was because most of the faults which would involve its operation would necessitate shut down of one generating unit. The main purpose of the system seemed to be that only one out of eight gas circulators would be shut down under any but the most rigorous fault conditions. If the loss of two circulators could have been faced, it would have been possible to have avoided the quick-switch scheme, which he felt was difficult and might lead to malfunction. He commented on the estimate of 15% of net generated output going for auxiliaries; 12% was the proportion for most English nuclear stations.

MR G. P. BUGDEN said that experience of the quick-switch schemes showed that circuitry was not very complicated unless an effort was made to restore supply in a few cycles. If a second or two was allowed it was very simple to initiate a closing switch.

MR H. HEIMER also remarked that the circuitry of the quick-switch scheme was not complicated. It was hoped that the 25% voltage criterion for permitting switching would be reached in about one second after a fault. He commented on the "tremendous" amount of paper work involved in nuclear station work, particularly in drawing up commissioning schedules.

MR F. MARSHALL thought there would be more temperature cycling of the fuel elements than at Calder Hall or Chapel Cross. As regards lighting of the fuel element cooling pond, he thought seeing into a pond would be difficult if a wind were disturbing the water surface. He suggested that the bus-section switch in the units supply scheme was a source of weakness, since if anything happened to it, essential supplies were lost.

MR J. SOLOMONS pointed out that there was no interlocking to prevent paralleling of more than one transformer on the 6·6 kV system. Reliance was placed on operator, discipline and care rather than interlocking. He inquired how this fitted in with the failure-safe philosophy.

MR B. H. STONEHOUSE spoke of the choice designers were faced with, between relatively simple equipment with few faults and the complexities of ensuring that hardly any faults would be dangerous. He instanced two designs considered recently, one of which had a failure expectancy of one fault in 2,000 hr, but only one fault in 200 years would fail to danger; while another design gave one fault in 20,000 hr expectancy, but faults were equally divided between failure to safe and failure to danger.

Replying to the discussion, MR G. F. KENNEDY said that generating stations had got to undertake the task of following the load and it was necessary to expect nuclear stations to operate on part load. He said that provision to expand Hunterston had been made because of the shortage of suitable sites in Scotland. Those concerned with Hunterston were confident that high-load factors could be achieved at the nuclear station, where heating surfaces were under nuclear clean conditions so different from fuel-fired stations.

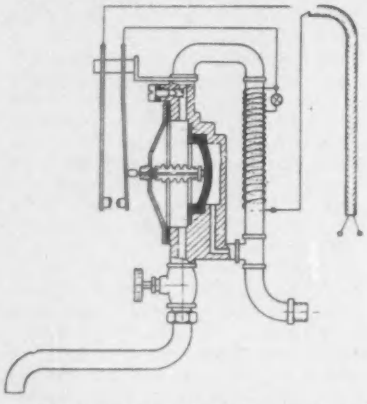
Another of the authors, DR K. J. WOOTTON, remarked on the number of contributors to the discussion who had mentioned complication of failure-safe philosophy. He sometimes felt that engineers provided for accidents they could cope with and ignored those they knew they could do nothing about. He said that the gas circulators had been tested, so far as mechanical plant was concerned, at one-third scale to establish aerodynamic characteristics. The basic design was well proved in other applications. D.C. motors for driving the gas circulators would not be adopted nowadays. This was because experience had demonstrated that it was a good thing to use more of the reactor power in circulating gas. In subsequent designs a back-pressure steam turbine was used as the drive.

PROGRESS IN PATENTS

SELECTED SPECIFICATIONS

Diaphragm Switch

Specification 883,386, in the name of A. Eckerfeld, of Essen-Ruhr, Germany, concerns a special form of control diaphragm for electric water-heaters of the non-storage type. It is usual, in such heaters, to provide a diaphragm which operates on differential pressure to control the



This continuous water heater incorporates a novel diaphragm switch

electrical heating circuit, ensuring that current is not applied to the heating element when no water is flowing.

In the device described, the diaphragm is of the dished type and, in addition, is a bimetallic element which will "snap over" at a predetermined temperature to give an added safeguard should the water passing through the device exceed the safe value. In practice, the operation of the diaphragm is dependent on the joint forces of differential water pressure and temperature and the adjustment of the pressure by-pass screw is, therefore, a means of regulating the temperature of the outflowing water.

Contact Materials

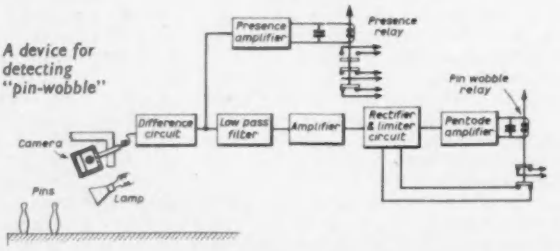
The use of materials incorporating a refractory constitutent, such as tungsten or molybdenum, in conjunction with a high conductivity constituent have been widely used in recent years, since they combine the hardness and arc-erosion resistance of the refractory metal with the heat and electrical conductivity characteristic of the conducting metal. The methods used for making the contacts, comprising forms of sintering, repression, coining, etc., are generally unsatisfactory in that the density for good physical properties and contact performance is difficult and inconsistent in achievement.

Now Mallory Metallurgical Products Ltd., of Hatton Garden, London, discloses, in Specification 883,429, that they have been successful in producing high-density refractory contacts by simple powder metallurgy techniques, involving a single pressing and sintering operation, by the expedient of adding ½ to 5 atomic % of silver to the mixture. It would seem that silver in solid solution in copper serves as a densifier, changing the surface energy of the matrix and preventing "copper bleeding" during sintering. The silver added must not exceed 5 atomic % or low-melting copper-silver eutectic will form.

Wobbly Pins

A means for detecting "wobbly pins" might, quite excusably at this season of the year, be taken as an alternative to a "breathalyser." Fortunately, the home-going reveller need have no qualms. The "lane" on which he might encounter one is not the leafy kind but the highly polished wooden run to which our American cousins have elevated the fine old British game of skittles. At the end of the lane, behind the skittles or "pins," is a complex mechanism which clears away fallen pins after the first ball, lifting the standing ones to do so and then repositioning them. After the second ball, it clears all pins and sets down a fresh batch in position to within an accuracy, so we are informed, of less than $\frac{1}{10}$ in. This mechanism, electrically controlled and operated, is known as the "pinspotter" and it also registers "strikes"—when all pins are felled by a single ball—and the numbers of pins left standing.

But, it seems, this is not enough. The pins, which have a narrow base and comparatively high centre of gravity, are inclined to wobble if they receive a glancing blow from a ball or other falling pin. It is important that the repositioning mechanism shall not descend too soon or it may knock over the pin, to the ire of the player. Alternatively, it could steady a pin which might otherwise have fallen, to the ire of his opponent. You can't please everybody.



A device for detecting "pin-wobble"

So the American Machine and Foundry Company, of 261 Madison Avenue, New York, have devised a method which detects "wobbly pins" and holds up play until they have steadied themselves. Did we say *a* method? There are three. The first is "optico-electronic"; the second "inductance sensing": the third "capacitance sensing." All are described in Specification 881,903. But let us take the first. Each pin is monitored by a photo-electric cell behind a special mask and the signal is passed to a "difference circuit." Here, one part is passed to a "presence amplifier" and a "pin presence relay," while the other is passed, in sequence, through a "low-pass filter," "amplifier," "rectifier and limiter circuit," "pentode amplifier" and, finally, the "pin wobble relay." There is one set of all of these for each of the ten pins, and only when all 20 relays are energised can the machine carry on "pinspotting."

It's enough to make your pins wobble!

Reproduced by permission of the Controller of H.M. Stationery Office. Copies of specifications may be obtained from the Patent Office (Sales Branch), 25 Southampton Bldgs, W.C.2. Price 3s 6d.

Static capacitors for the grid

132 kV BANK AT FLEET SUBSTATION

AT the Fleet substation of the CEGB, a 41·7 MVAr capacitor bank has recently been commissioned to compensate for the lagging power factor of the load. Fleet substation is one of the points at which supplies are drawn from the 275 kV supergrid to feed the London area, and it is connected to the 275 kV system through substations at Melksham and West Weybridge.

Last winter, the peak demand on the grid system rose to 24,445 MW, the peak occurring on December 13. As it happened, the following January was devoid of cold spells, but it was estimated that the peak load could have risen to 25,000 MW, which would have taxed the transmission and distribution system, particularly to the London area. For some years past in the London area the rate of growth of electrical demand has been increasing rather more rapidly than the figure of about 7% per annum for the country as a whole.

In preparation for the demand anticipated in future years, manufacture is now going ahead on synchronous condenser plant, which will be installed at the Fleet substation; but, as an interim measure before they are commissioned, the bank of static capacitors has been installed. These have been supplied by ASEA of Sweden through Fuller Electric and were commissioned at the beginning of December, eight months after the contract was placed.

Position of Capacitor Bank

The Fleet substation has two 120 MVA autotransformers interconnecting the 275 kV and 132 kV systems, and the capacitor bank is connected on the 132 kV side of one of these transformers. The transformer phase connections are taken direct to 132 kV air-blast circuit-breakers, and the connections to the capacitor banks are teed off from them through isolators. The capacitor bank is connected in star across the three lines with the neutral point earthed. Each phase of the capacitor bank is split into two parallel paths, partly for convenience in assembly but also for the fault-detection system used.

Each of these two paths/phase is made up of capacitor units, connected three in parallel and 64 in series. In the complete bank there are, therefore, over 1,000 capacitor units. A current transformer connects the mid-point of the capacitor units in each path, so that any unbalance in the current distribution in the two paths will give an output from the c.t.

In addition to the subdivision referred to above, each of the two phase paths are arranged in four groups mounted on steel platforms. These platforms are supported on one, two, three or four standard insulators, depending on the voltage to earth of the group. In this way, the insulation between the phases and earth can be graded, but provision is made to reinsulate for full line voltage if this should be required at a later date.

Capacitor Units

Each capacitor unit is rated 1,190 V r.m.s., 36 kVAr. It has a single insulated terminal, the other set of foils being connected to the can and so improving the cooling. Cooling is also facilitated by fins on that end of the capacitor can, which is used for fixing. The capacitors are fixed to vertical-channel section beams and this method of mounting is said to give very good cooling. The capacitor units are filled with highly purified and degasified mineral oil at a pressure of 2 atmospheres to 3 atmospheres, pressure changes being accommodated by the flexibility of the hermetically sealed containers. Each unit contains 21 individual capacitor units and these are connected through fuses to the insulated terminal.

The capacitor units do not include discharge resistances, and when the bank is switched off they discharge through the transformer winding. Provision is made, however, to earth the units. This is done in one operation by a master handle which earths first the mounting platforms and then the 16 columns of capacitors on each platform.

Protection

The capacitor bank has a compensated current balance protection circuit for each phase in addition to thermal overcurrent protection and balanced earth fault protection. Because one end of each capacitor phase bank is connected as an earthed star point, it has been possible to arrange for the c.t.'s used for overcurrent, earth fault and out-of-balance current compensation to be insulated for 11 kV only. The c.t.'s between each phase path mid-point are insulated for operating at 38 kV to earth.

The compensate current balance protection scheme installed is designed to compensate for a capacitor fuse failure. It will be recalled that in each capacitor can there are 21 units, each protected by a fuse. Failure of one of these individual capacitors would blow the fuse and therefore cause the current in the two phase paths

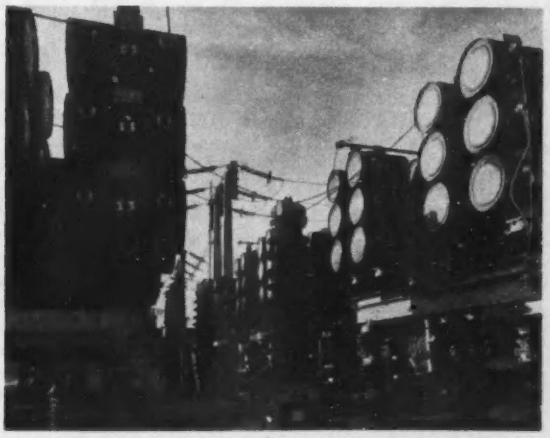


Fig. 1. Part of the 41·2 MVAr, 132 kV static capacitor bank at the Fleet substation of the CEGB. The capacitor units are connected in series-parallel between each line terminal and an earthed start point. The current transformer in the centre of the picture is part of the alarm equipment for detecting a fault in the bank

to become slightly unbalanced. More severe unbalance would result if a complete capacitor can unit failed and this would, in fact, result in a 50% overload on the two other capacitor units connected in parallel with it in the phase path. The compensated current balance circuit is sufficiently sensitive to detect the failure of eight out of the 21 fuses in one capacitor can, occurring in only one can of the phase bank. This corresponds to an out-of-balance current of 0·2% of the phase current.

The effect of this amount of out-of-balance would be to give an alarm in the control room; provision is made, however, for instantaneous tripping of the capacitor bank and its associated transformer if the out-of-balance current rose to 0·8% of the phase current. To give the sensitivity required, the out-of-balance current protection scheme includes a compensating circuit fed from a c.t. in the neutral point. In setting up the circuit, the output from this c.t. is set to compensate for any out-of-balance current in the two capacitor phase paths resulting from slight differences in performance of the units. The compensating circuit makes it unnecessary to trim the various sections of the capacitor bank.

The thermal overcurrent relay connected to each phase is compensated for harmonics. This relay has a time constant of 40 minutes corresponding to that of the capacitor bank and only gives an alarm. Since the capacitor bank does not have its own circuit-breakers, it is incorporated in the 120 MVA transformer protective zone.

The consultants for the scheme were Kennedy and Donkin. Support insulators for the capacitors were manufactured by Steatite and Porcelain and earthing equipment by Power Connectors.

ACCIDENTS AT HOME

EXPERIENCE during 1960 confirmed that electricity is the safest form of fuel—but, once again, it emphasised that installation and maintenance of electrical equipment should be undertaken only by skilled and experienced persons. That is the opinion of Mr S. J. Emerson, HM Electrical Adviser to the Home Office, stated in a covering note issued with his annual précis of the circumstances of fatal domestic accidents. The present list covers 1960.

As shown in the accompanying table, there were 49 accidents in this category, compared with 79 in 1959. Particularly noticeable amongst the reductions in accidents is the fall in fatalities associated with electric blankets (seven in 1959), in electric heaters (ten in 1959) and in cables and flexibles (13 in 1959). It is, presumably, a change in classification which results in there being no entry for "plugs, sockets, adaptors and connectors," against which heading 16 fatalities were recorded in 1959.

Accidents in bathrooms include two cases where old people had electric fires balanced at the end of their baths. Electrocution followed when the fire fell into the bath. In another case a child was electrocuted when an electric hairdryer fell from a window sill into a bath, while a girl of 19 met her death when, sitting in the bath, she attempted to change a record on an electric record player.

Switches in the neutral conductor once again feature in the summaries of accidents. This year there is an example of the classic pattern of accident from this cause. A child of three was electrocuted when he touched the element of an electric fire. Because a switch was in the neutral instead of the live conductor, the element was alive, although not hot or glowing, when the switch was in the "off" position. Mr Emerson emphasises the lesson this accident presents in the importance of isolating portable equipment when not in use by withdrawing the plug. In another accident, a baby under two years of age was electrocuted when he put his finger into a lampholder from which the bulb had been removed. Here, again, the single-pole tumbler switch controlling the switch was connected in the neutral circuit.

One of the few classes of appliance in which there were more fatalities in 1960 than in 1959 was wash boilers and washing machines. In all six cases recorded, the metalwork became live owing to electrical faults.

Accidents resulting from errors in connecting plugs, or from poor design of plugs, figure prominently in the report. In a number of cases, leads became loose and the earth wire touched one of the live terminals, or a live wire touched an earth terminal. Mr Emerson comments that to avoid this serious hazard BS plugs should be used, in which live and neutral terminals are adequately separated from the earth terminal.

A variation of this fault is incorrect connection of plugs, with cross-connection of earth and live leads in the flexible. Use of a three-core cable terminated in a two-pin plug was in one case responsible for a similar accident. The unconnected green (earth) conductor was touching one of the live pins in the plug.

Fatal Electrical Accidents in the Home, 1960

Domestic Premises	
Electric heaters, radiators, etc., and fires (three in bathroom) (includes two children—one in bathroom)	8
Cables, flexibles, etc.	8
Radio, TV and gramophone sets and aerials (one in bathroom)	2
Electric irons	3
Portable lamps	1
Electric kettles	2
Electric blankets	1
Vacuum cleaners	3
Electric drills and other tools	1
Electric hairdryer (one child in bathroom)	1
Electric wash boiler and washing machines	6
Electric lawn mowers	1
Lampholders and pendant switches (one child)	1
Miscellaneous Domestic Premises	
Portable and other lamps	2
Electric tools (drills, etc.) (one child)	4
Unclassified	5
Total	49

Use of brass lampholders caused the death of two men who were handling them while standing on conducting floors. Here the answer is to use only shock-proof skirted lampholders in such circumstances. Overhead lines caused a number of deaths. In several of the cases, those killed were handling metal objects. A farmer was dislodging a bird's nest with an aluminium pole, a youth was picking apples while standing on an aluminium ladder, a telescopic TV aerial touched a live o.h. line, and the control wire of a model aeroplane touched an overhead line.

Low Temperature Industrial Furnaces

FACTORS AFFECTING HEAT TRANSFER IN MODERN TYPES

by J. McMullen, F.I.M.*

IN industrial heating furnaces for the metal working industries, particularly those required for the various heat-treatment processes, a high degree of temperature uniformity must obtain throughout the charge to ensure that the final properties of all the components are within the material specification limits. At high temperatures, i.e., over 700°C approximately, temperature uniformity in the conventional furnace seldom presents any special problem. This is particularly true in the case of the electric resistance furnace where it is relatively simple to adjust the heat input to suit the various demands, both in different parts of the furnace and at different stages of the heating or cooling cycle. At lower temperatures, however, the rate of radiant heat transmission becomes progressively lower and, with heat-treatment processes carried out below 700°C, temperature uniformity has often presented problems.

Typical processes conducted in this temperature range include the drawing and tempering of steel, the annealing and stress-relieving of some non-ferrous alloys, the temper-hardening of some of the copper base precipitation hardening alloys and the stabilising, solution heat-treatment, annealing and ageing of light alloys. In all of these cases, accuracy and reproducibility of temperature conditions are important from the point of view of final properties, but the degree of accuracy required from a given furnace may vary with the alloy concerned. The temperature range for aluminium alloy treatment is, for example, particularly narrow. In addition, aluminium has a high thermal capacity and a highly reflective surface so, at low rates of heat transmission, it is slow in attaining temperature. Light alloy heat-treatment furnaces have always called for special consideration.

* Chief Metallurgist, Efco Furnaces Ltd.

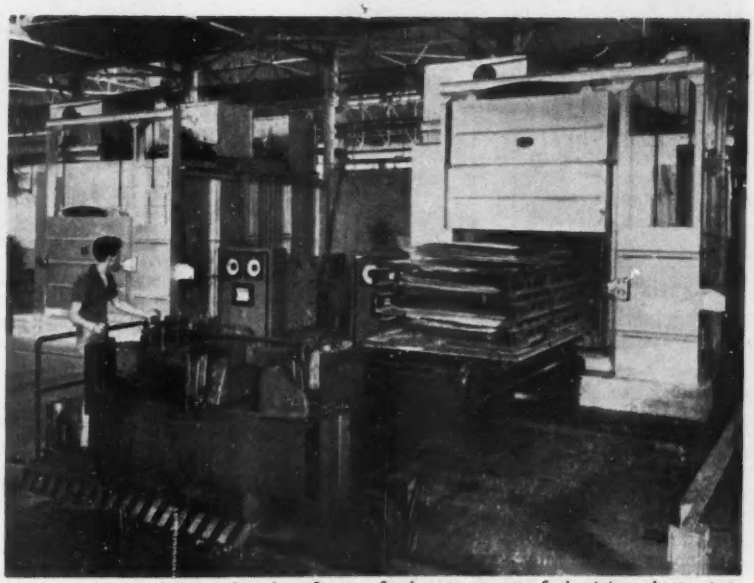


Fig. 1. Loading a horizontal cyclone furnace for heat-treatment of aluminium sheets up to 14 ft by 6 ft (High Duty Alloys Ltd.)

In this article it is proposed to consider some of the factors affecting heat transfer at these low temperatures and to describe the types of furnaces which industry has made available to meet the critical requirements of modern heat treatment.

Furnace Capacity

We may define the heating capacity of a furnace as the weight of material that can be heated to a particular temperature in unit time and it is clear that, in a given furnace, this capacity will be governed primarily by the rate of heat release within the heating chamber. Of the total heat released, the proportion available for heating the charge will be governed by furnace losses, i.e., heat lost by conduction through walls; heat radiated through the doors and other openings; loss to the flues in fuel-fired furnaces and, in the case of electric resistance furnaces, smaller losses through cables and, where used, transformers. These losses, the magnitude of which will vary with the operating temperature of the furnace, are known with reasonable accuracy so that, for a given connected load, the net heat available is readily determined.

The maximum hourly output, however, may not depend solely on the rate of heat liberation. It may be limited by

(1) The rate at which it is transmitted from the source to the surface of the components constituting the charge, and

(2) The time required for this heat to be conducted from the surface to the centre.

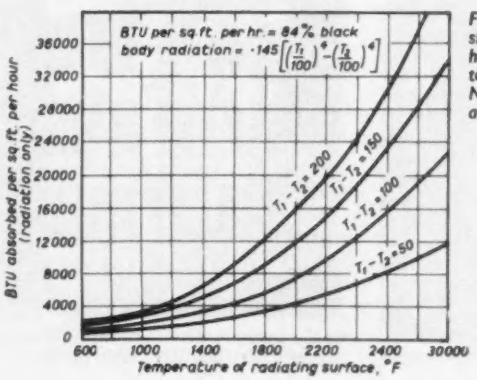


Fig. 2. Graph showing rate of heat transfer with temperature Note, °F not absolute (Trinks)

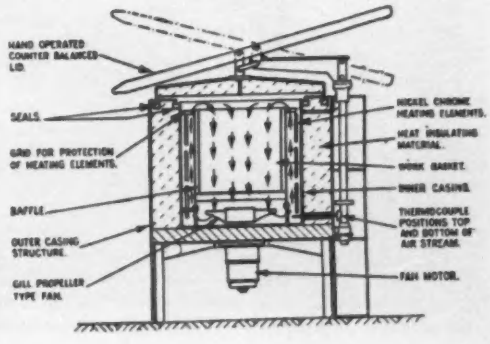


Fig. 3. Diagram of electrically heated vertical, forced air circulation furnace

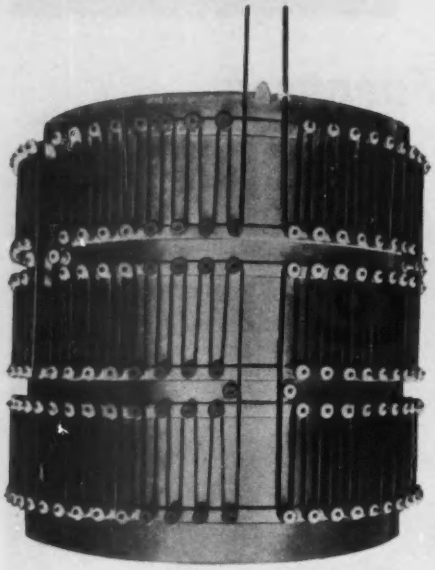


Fig. 4. Element arrangement of forced air circulation furnace shown in Figs 3 and 5

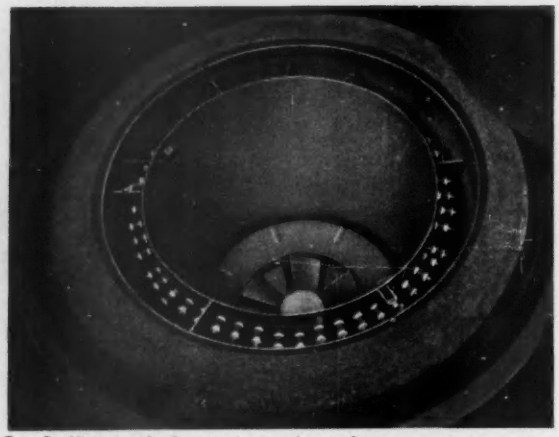


Fig. 5. View inside forced air circulation furnace emp'oying heating arrangements as depicted in Fig. 4 and showing baffle, elements and fan

In the case of thick materials, such as billets, this diffusion time can be appreciable and so restrict furnace output. This also applies to charges of low thermal conductivity, such as coiled strip, particularly when bright. In the case of thin material, or material of high thermal conductivity, the time for diffusion will be relatively unimportant and furnace capacity will be governed by the rate of heat release within the chamber and the efficiency at which the heat is transferred to the surface of the stock under treatment.

In general, heat transfer in a furnace is effected by a combination of radiation, convection and conduction. Conduction is of importance in lead or salt baths. In dry furnaces, providing that correct space loading of the charge is employed, conduction plays no part in heat transfer and is of importance only in so far as it affects diffusion throughout the mass as indicated above.

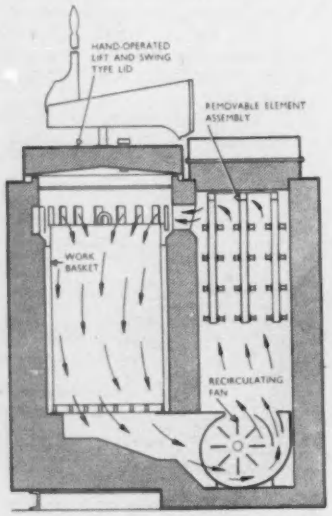


Fig. 6. Diagrammatic section through vertical type cyclone furnace showing air circulation

Radiant Heat Transfer

In considering radiant heat transfer in general, a distinction must be made between surface, or solid, radiation and gas radiation. In fuel-fired furnaces the charge receives a measure of radiant heat from the gaseous products of combustion. According to Schack,[1] the heat transmitted by this means is in proportion to the partial pressure of the carbon dioxide and water vapour in the gas, the difference in temperature between the stock and the gas and the thickness of the gas layer. The major heat transfer, however, is by surface radiation from the furnace walls to the charge. In electric resistance furnaces there are no products of combustion and radiant heat transfer is by surface radiation only, which proceeds approximately in accordance with the Stefan-Boltzmann law, a simplified form of which is

$$Q = 0{\cdot}173\ EA\left[\left(\frac{T_1}{100}\right)^4 - \left(\frac{T_2}{100}\right)^4\right]$$

where Q = Total heat received, B.Th.U./hr.
A = Receiving surface in sq ft.
T_1 = Absolute temperature in degrees F of emitting surface.
T_2 = Absolute temperature in degrees F of receiving surface.
E = Emissivity factor.

Two points arise from this. The first is that the coefficient of radiation increases with the difference between the fourth power of the absolute temperatures of the emitting and receiving surfaces and not just with the temperature difference. This means that, at high temperatures, only a small temperature difference is required to bring about a considerable increase in radiation. This is perhaps more clearly brought out in Fig. 2 and is the main reason why temperature uniformity is so much easier to obtain at higher temperatures.

The second point is the importance of the emissivity factor. It is fundamental that a body will absorb heat at the same rate as it would emit heat if it were the radiating source. The emissivities of the various metals are available in the handbooks and, although the actual values vary with alloy composition and the nature of the surface, the figures reproduced in Table 1 show the pronounced effect of a bright surface on the magnitude of the radiation coefficient.

Table 1. Emissivities of Metals at 540°C.

Polished Aluminium	0·075
Oxidised Aluminium	0·1/0·3
Polished Brass	0·06
Oxidised Brass	0·25/0·60
Polished Copper	0·080
Oxidised Copper	0·55/0·75
Bright Steel	0·25
Oxidised Steel	0·85

Convection Heat Transfer

Convection heat transfer involves the conduction of heat across the stationary gas layer adjacent to the metal surface and occurs when the gas has a velocity relative to the surface and is of a different temperature. Because of the low thermal conductivity of gases, heat transfer by natural convection, such as occurs in the electric furnace with a non-stirred atmosphere, is negligible. It is of little significance in fuel-fired furnaces despite the higher velocity of the

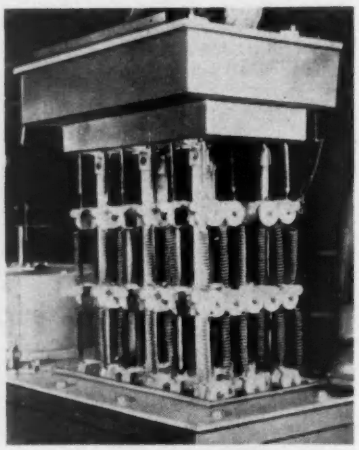


Fig. 7. Complete element assembly withdrawn from a vertical type cyclone furnace

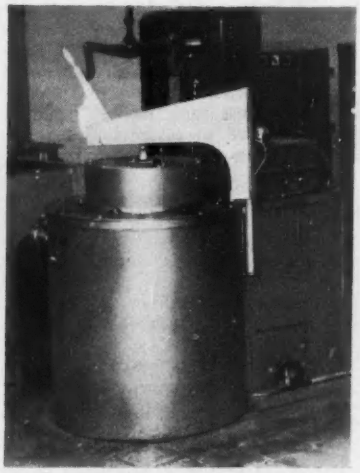


Fig. 8. Cyclone furnace used for stress-relieving taper roller bearings (Gamet Products Ltd.)

combustion products. With "forced convection" as produced by recirculating fans, the thickness of the boundary layer is reduced and heat transfer is then proportional to the mass velocity of the moving gas and the temperature difference between gas and stock. Unlike radiant heat transfer, it is for all practical purposes independent of temperature level and is given by

$$Q = H(t_1 - t_2) \text{ B.Th.U./sq ft/hr}$$

where H = convection coefficient, and

t_1, t_2 = temperatures, in °F, of the gas and metal surfaces, respectively.

W. J. King[2] gives the values of H for the average surface as $0{\cdot}8 + 3{\cdot}15$ d.v. at velocities less than 15 ft/sec and as $0{\cdot}56(14{\cdot}3$ d.v.$)^{\frac{1}{2}}$ for velocities greater than 15 ft/sec; where d is density of hot gas and v, the velocity in ft/sec.

Because of the slower rate of convective heating as compared with radiant heating, there is little point in increasing the proportion of heat transferred by convection where the operating temperature is high. At low temperatures, however, recirculation of the air is of considerable assistance in both speeding up the heating cycle and ironing out non-uniformity of temperature.

Types of Furnace

Early efforts to assist radiant heating by a measure of convective heating consisted of positioning a paddle-type fan in the roof of the furnace. In these conditions, a mere disturbance of the atmosphere is produced and the ironing out of temperature irregularities occurs only when the charge is adequately spaced. With economic loading of a furnace, and particularly for the treatment of small or medium sized parts in bulk, the air must be circulated in a well defined path.

The simplest method of doing this is to fit a shield or baffle in front of the heating elements with a fan positioned either at the top or bottom of the baffle so that the air can be drawn through the charge and returned via the heating elements. With an effective door seal the air is thus recirculated in a closed system.

Fig. 3 shows the arrangement of a small vertical cylindrical "forced-air circulation" furnace. In the size illustrated this furnace is extensively used for the tempering and stress-relieving of steel parts in bulk as well as for light alloys and non-ferrous alloys. A high loading density is, therefore, usual.

In the design shown, the fan is positioned at the bottom and the charge basket is fitted with a grid base. The air is, therefore, drawn down through the charge and returned via the heating elements. Temperature equipment includes a two-point recorder with two thermocouples positioned in the air stream above and below the charge. Temperature attainment is indicated by merging of the curves. It should be noted that both the heating chamber and the underside of the door are metal lined and a door seal is fitted to avoid air spillage.

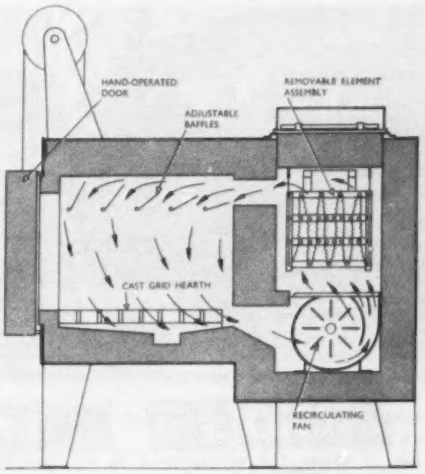


Fig. 10. Diagrammatic section through horizontal type cyclone furnace showing circulation flow of hot air

Figs. 4 and 5 show the baffle and heating element arrangement. In low temperature short-cycle operations, heating elements are designed for operation on mains voltage. Alternatively, a transformer can be supplied to permit the use of the heavy tape elements as shown in the illustration.

The forced-air circulation system is applied to the larger pit furnaces, rectangular box furnaces and continuous furnaces. In the case of the larger pit furnaces, the door is either pneumatically or electrically operated and, depending upon furnace size, the fan may be positioned in the door instead of the base. This arrangement facilitates maintenance and avoids the complication of additional supporting structure to carry a heavy charge above the fan. Rectangular box furnaces are installed wherever horizontal loading is preferred and the fan is then positioned in the back wall or roof.

In continuous furnaces, fans are again positioned in the roof and, as in the case of the larger batch units, the furnace may be zoned so that the heat input can be varied to match the requirements of the load.

In all the above cases there is a considerable transfer of radiant heat. In fact, at the top of the relevant temperature range it is likely to be the predominant factor. In the simple furnace shown in Fig. 3 the baffle is the source of radiation as far as the charge is concerned and serves to iron out temperature irregularities that would occur if the charge were exposed to direct radiation from the resistors. Although the air does supply convected heat to the interior of the load. its main function is to even out the high temperature spots by scrubbing the surface of the components, particularly those nearest the baffle. Existence of such high temperature areas can, however, be avoided by

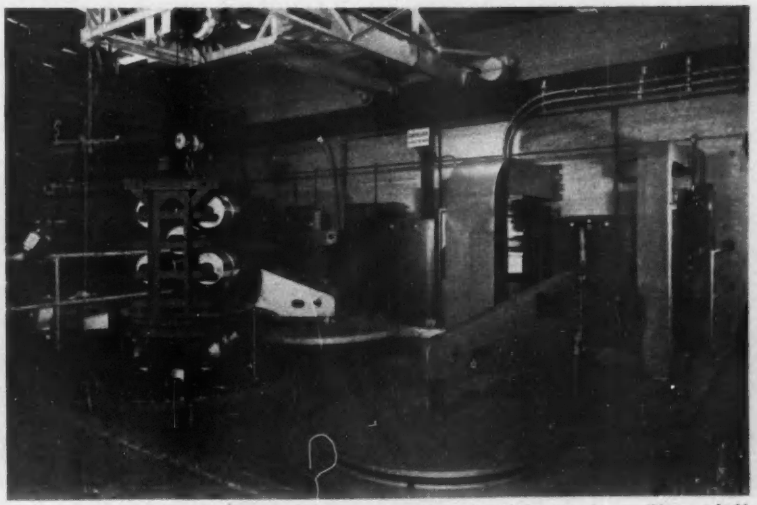


Fig. 9. Pit-type cyclone furnaces used for annealing aluminium foil on spools (Venesta Ltd.)

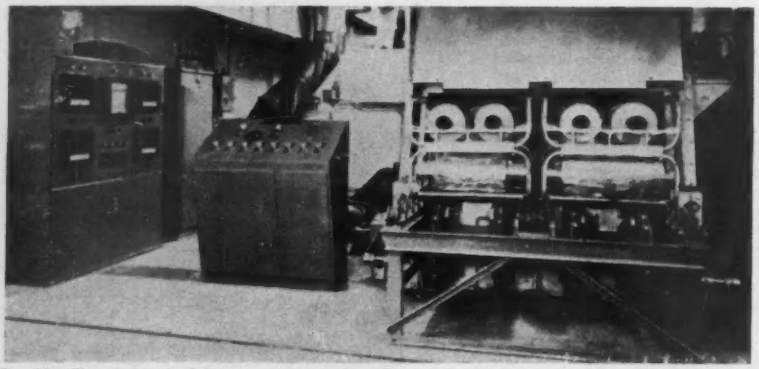


Fig. 11. Charging end of chain conveyor cyclone furnace for annealing aluminium foil on spools

separating the source of heat from the work chamber.

Fig. 6 shows the arrangement of a vertical cylindrical furnace of the cyclone type and having similar capacity to that shown in Fig. 3. In this type of furnace, heaters and fan are separated from the work chamber, an arrangement which avoids direct radiant heat transfer. All transfer is by convection and furnace performance depends directly on the volume of the recirculating air. For this reason, powerful, high-speed fans are fitted and the high velocities obtained result in the penetration of very dense charges. As shielding from radiation does not have to be considered, the utilisation of charging space can be high and loading densities of more than 30% are common.

An important advantage of this system is that the fan and heater box is accessible for maintenance without the necessity of cooling the whole furnace down. Fig. 7 shows the removal of a heater assembly. Elements, which are of 80/20 nickel-chromium in coil form, are supported on refractory spools and supplied for mains operation.

A vertical furnace having useful loading dimensions, 16 in. dia by 20 in. deep, rated at 27 kW and installed for the tempering and stress-relieving of taper roller bearings is illustrated in Fig. 8.

Fig. 9 shows two such furnaces installed for the annealing of aluminium foil on spools and having useful dimensions, 5 ft 6 in. dia by 9 ft 6 in. deep, and rated at 200 kW. It should be noted that, to avoid "crinkling," temperature uniformity in the annealing of this material is considered to be critical.

The adaptation of the cyclone system to rectangular furnaces is illustrated in Fig. 10, and Fig. 1 shows two single-ended units installed for the annealing, stabilising and ageing of aluminium and aluminium alloy sheet. Each furnace has useful dimensions, 15 ft 3 in. by 6 ft 6 in. by 4 ft 6 in. high, rated at 280 kW and is controlled in two zones with four external heaters positioned in the roof.

The system has also been applied to conveyor furnaces. It should be noted, however, that, as continuous furnaces are normally open-ended, provision has to be made to permit the air recirculation to be, as far as possible, within a closed system.

Fig. 12 shows the discharge end of a chain conveyor furnace installed for the annealing of aluminium foil on spools at the rate of 1 ton/hr. This plant has been in use for several years, and shown that the critical requirements for aluminium foil can be met in this type of furnace. The unit comprises a heating chamber 29 ft long and a cooling chamber 77 ft long, with door openings of 6 ft 6 in. wide by 2 ft 9 in. high. It is rated at 300 kW. The furnace is lined with aluminised mild steel, and inlet and outlet roller tables are provided. The charging end of the same furnace is illustrated in Fig. 11.

Conveyor System

There are four chain conveyors. Two high-speed units are for transferring the charge from the inlet table to the heating chamber and transferring from the heating chamber to the cooling chamber, respectively. The two slow-speed conveyors are for conveying the charge independently through the heating and cooling chambers, pawls being provided on the chain to engage with the tubular charge carriers. The pitch of the pawls is so arranged that traverse through the two chambers is independent. Inclined sliding-type doors of heavily lagged cast iron are fitted and their movements are synchronised with the high-speed conveyors. The furnace is divided into four independently controlled zones, each with its own heater box comprising an easily removable heater bank, a centrifugal-type fan and an excess temperature device. The heated air is drawn, via ducts in the furnace roof, through deflector plates adjusted to ensure uniform flow through each zone, and is returned through similar ducts at the side.

Additional features include four cooling fans to supply cold air to the cooling chamber, the air being regulated by shutters in the ducting, and the provision of a system of dampers in the first two heating zones to ventilate the vaporised lubricant through the work. Since movement of the doors is synchronised with the conveyors, operation of the furnace is automatic and sequence controlled.

The convection heating system described shows, in practice, a considerable benefit in the way of temperature uniformity. This applies particularly to the lower temperatures. At all temperatures, however, the advantage of easy access for maintenance is of importance.

Consideration of furnace types has been limited to those where the recirculating medium is air. In an appreciable number of electrically heated furnaces, metallurgical requirements demand that oxidation of the metal under treatment be avoided. Air must, therefore, be absent. Standard practice is to build the furnace gas-tight and to pipe to the furnace chamber a controlled atmosphere generated external to the furnace of a composition that is non-oxidising to the alloy and at a rate sufficient to prevent ingress of atmospheric air. When the treatment is conducted within the temperature range now being considered, recirculating fans are essential to ensure uniform transfer of heat. In most cases, the charge has to be cooled under the protection of the controlled atmosphere and this demands design features which are considered to be outside the scope of this article.

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2. W. J. King: "The Basic Laws and Data of Heat Transmission." *Mechanical Engineering*, March-August, 1932.

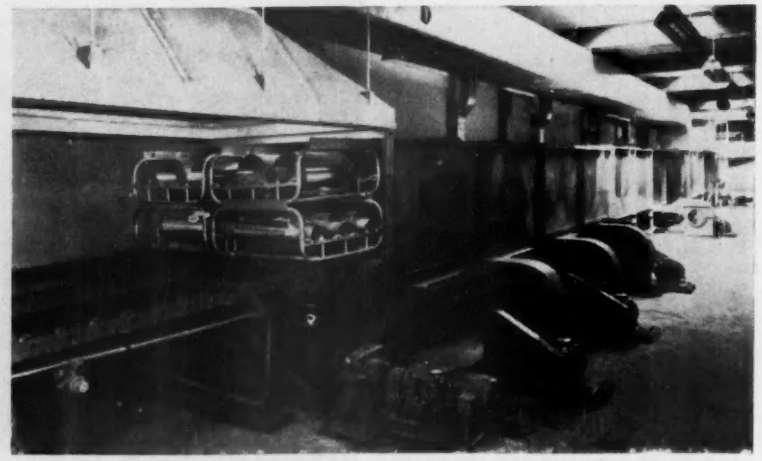

Fig. 12. Discharge end of the furnace shown in Fig. 11 above (Venesta Ltd.)

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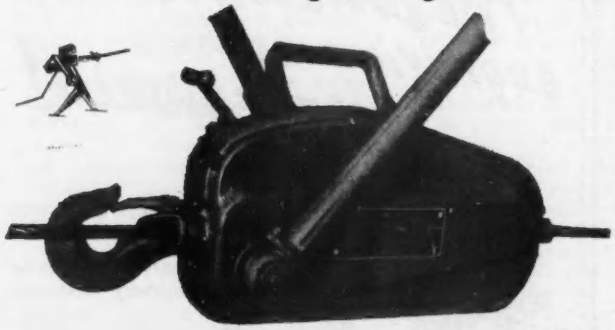

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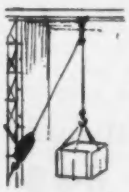

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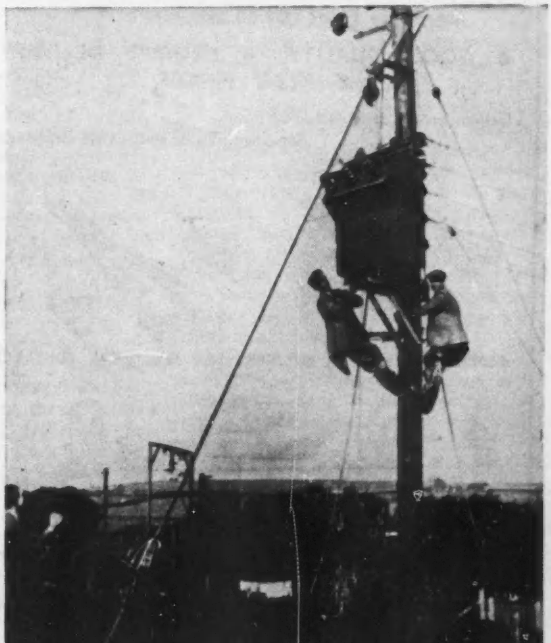

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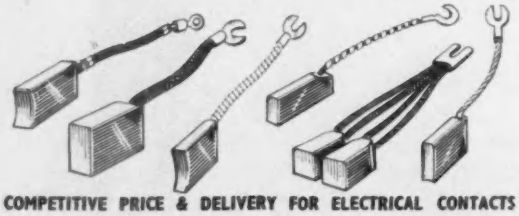

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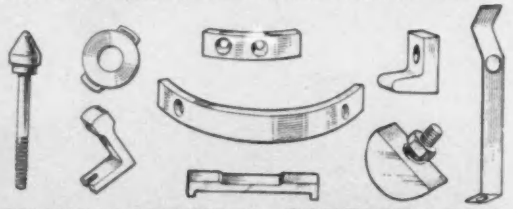

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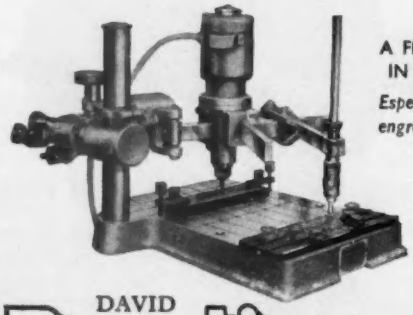

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Screening of H.F. Apparatus in Factories

THEORETICAL AND PRACTICAL ASPECTS OF ENCLOSURE DESIGN

UP to about 20 years ago, "screening" in the industrial sense related to protective guardworks erected around machinery or electrical equipment to safeguard personnel from injury or shock. With the introduction of high-frequency diathermic and induction heating equipment into general productive practice, the term has assumed a far more important significance and one which, in terms of the enclosure design, necessitates something more than a basic general knowledge of structural engineering.

The main object of h.f. screening is, of course, to prevent interference with radio and television receivers in the vicinity. Apart from this, however, there is an increasing amount of electronic equipment in ordinary factory usage, much of which is also sensitive to unwanted electromagnetic radiations which, if they happen to be on "sympathetic" wavelengths of any amplitude, can cause maloperation of a kind which is not easy to detect.

The function of the screen is to serve as a barrier which partially absorbs and partially reflects both electrostatic and electromagnetic radiations from the h.f. source. In practice, no matter how efficient the design, a small proportion of the radiated energy must get through. The effectiveness of the screen for its purpose is expressed as a quantitative figure of merit, the ratio of the radiated energy which can be picked up on one side of the screen to that on the side farthest from the source. It is usually determined by measuring the field strength of corresponding points on either side of the screen. This ratio is sometimes referred to as the "insertion loss," but more commonly by the simple term, "attenuation."

The attenuation which a screened enclosure has to provide is a function of frequency and this may be anywhere between a few kc/s to several Mc/s. The screen material can be of solid metal or of metal mesh, either totally or partially surrounding the apparatus which contains the source of radiation. The enclosure may be of any size, from a small "can" to a large building capable of housing a piece of equipment weighing many tons. There is a relationship between the attenuation, wavelength and size of enclosure and the effectiveness of the screening will depend much upon the proper relationship between the size of screen distance from radiating source and material from which the screen is to be fabricated.

The cost of a large screen for a major enclosure is, in general, surprisingly high. It is, therefore, desirable that the first design should be based on some fundamental form of calculation rather than on trial-and-error techniques. Unfortunately, this is by no means a simple task and, though there has been a considerable amount of published matter on the theory of screening generally, some dating back 70 or 80 years to the days of Hertz, Rayleigh and Thompson, little of it is in a form which can be directly applied to such design studies.

A report* by the Electrical Research Association on the subject serves to bring together a great deal of the fundamental theories and endeavours to apply them to the wider aspect of screen design for industrial, laboratory and electronic equipment, such as the small cans shielding valves, coils, capacitors, etc., from interaction.

Speaking of interaction, it is well to remember that, since a metal screen works by reflecting part of the intercepted energy back to the source, it can, in many cases, affect the actual performance of the appliance which it is screening. Instances are known where output of high frequency induction equipment has been considerably impaired by badly designed or wrongly positioned screens.

Theory of Screening

Without going into the mathematical determination of the attenuation factors in a particular screen conformation—which are extensively dealt with in the report for those who wish to make a specialised study of the subject—it can be said that the purpose of screening technology is to insert a discontinuity in the medium which is propagating the radiations. The radiations are of two kinds, electrostatic and electromagnetic and, as is well known, these are propagated at right angles to each other. A continuous conducting shell around the source serves as a complete reflector of the electrostatic field, but not of the magnetic field. The latter, however, generates circulating currents by induction within the metal of the shell and, since this has resistance, part of the energy of the magnetic field is absorbed as I^2R losses in the shell.

It follows that the insertion loss or attenuation due to a screen depends partly on its shape and size and whether it is solid or open-mesh—these factors affecting the electrostatic reflection or "wave impedance"—and partly on the screening material which affects its electromagnetic absorption or "shell impedance."

Design of Screened Enclosures

It is not possible to develop a simple form of equation or method whereby a screened enclosure can be designed to suit a particular piece of equipment and to give a specified insertion loss, since the number of variables is large. In the majority of industrial applications, however, and with a proper appreciation of certain factors, a near approximation to the ideal can generally be achieved.

The designer has the choice of a number of materials, of which steel, copper and aluminium are the most usual, in solid or open form and he may adopt single- or double-skin enclosures with, in the latter case, cell or continuous construction.

At lower (kilocycle) frequencies, the d.c. resistance of the material assumes the main importance and the degree of attenuation will depend mainly on the total amount of metal employed with little regard to its distribution. At higher (megacycle) frequencies, distribution of the metal assumes paramount importance. That is to say, the more uniform the distribution of metal around the enclosure, the better will be the results. From the electrical viewpoint, solid sheet is always the preferred form.

Expanded metal is also excellent as a screen, since the electrical continuity within the sheet is good and the multiple sharp edges preserve continuity over the joints with other sheets. Moreover, it enables the equipment to remain under observation from without the screen.

At lower frequencies, an increase in thickness of the material gives less improvement in screening than the use of double thicknesses of metal to the same total weight. It is sometimes stated that, where double skins are used, only one electrical connection should be made between them, but it can be shown that multiple interconnections are better in practice. In fact, double screening is to be preferred whenever high attenuation is required from openwork screening at low (kilocycle) or very high (above 10 megacycle) frequencies, but the performance of any double-skin enclosure depends upon the efficiency of the bonding in so far as magnetic attenuation at lower frequencies is concerned. It is even more critical in cell-type enclosures; that is, enclosures comprising separate frames bolted together, each of which is wrapped around by the screening material. The method of bolting together must ensure complete line contact on both outer and inner edges of the screen and the same principle must apply to any doors in the enclosure.

Where a screen is not giving the desired attenuation or where the interference with other apparatus is such as to cause annoyance after the screening has been installed, it is usually advisable to consult a specialist on the subject.

* ERA Technical Report, M/T135: "Electromagnetic Screening," by J. Miedzinski, B.SC., A.M.I.E.E. Price 36s.

Supply and Distribution in Factories

IT is sometimes said that a wide gulf exists in the understanding between consultants engaged on the planning of factory buildings or extensions and their customers. This may be an exaggeration, but certainly there are far too many cases where post-building alterations to the electrical installation have to take place merely because the consultant was not fully briefed in the first case. Those who are responsible for factory management are often to blame, though the fault is more usually one of ignorance rather than intent.

One of the latest in a series of Factory Studies prepared by the Factory Building Research Committee concerns electricity supply and distribution* sets out to remedy the situation by setting down the basis of electrical planning for economic capital and running expenditure in a factory and so provide management with a sufficiently comprehensive reference for briefing specialist consultants.

The electrical installation must be expected to have a normal life of 20 years or more, though it is hardly likely that this period will elapse without the need for modification or extension to cater for progressive developments in production techniques and machinery. Intelligent anticipation of such possible future demand can make a valuable contribution to system flexibility; otherwise the cost of alterations which become necessary during the normal life could easily exceed the initial cost of the installation. The various factors which are relevant to economic utilisation of electrical power — load factor, diversity factor, power factor, etc.—must be understood and properly appreciated and, in addition, their effect on the economics and design of the system. For example, the choice of supply tariff and whether it includes maximum demand charges, penalties for low power factor, or other qualifying detail can vitally affect the size of the electricity bill when it is presented.

Private generation is only economic where the demand is such as to justify generators of a size comparable to those used in the supply board's stations, where a waste product is available as a fuel or where there is a large and constant demand for process steam.

Supply may be taken at high or low voltage. Up to 100 kVA will usually be met from the local board's 415 V three-phase distribution network. Above this, higher voltage supplies will normally be used with a transformer and switchgear in the board's substation either close at hand or actually on the factory premises.

Distribution within the factory will also be subject to considerations of load, length of cable run and available space for transformers and switchgear. Four graphs, reproduced below, serve to show how cable cost/kVA/1,000 ft drops with the adoption of higher voltages (Fig. 1), the relative cost/kVA of circuit rating of primary switchgear (Fig. 2) and secondary switchgear (Fig. 4) and cost/kVA of transformers of the three basic types (Fig. 3).

Generally speaking, greater flexibility and more economic layout is achieved by the use of simple substations installed at load centres throughout the factory, the larger the number, the greater being the overall service reliability.

There are other aspects of supply and distribution which are covered in the Study.

* Factory Building Study No. 10: "Electricity Supply and Distribution." HMSO. Price 3s 6d.

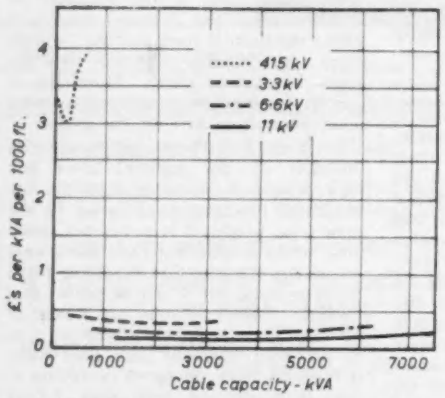

Fig. 1. Graph relating unit cost of installed cable with capacity and system voltage

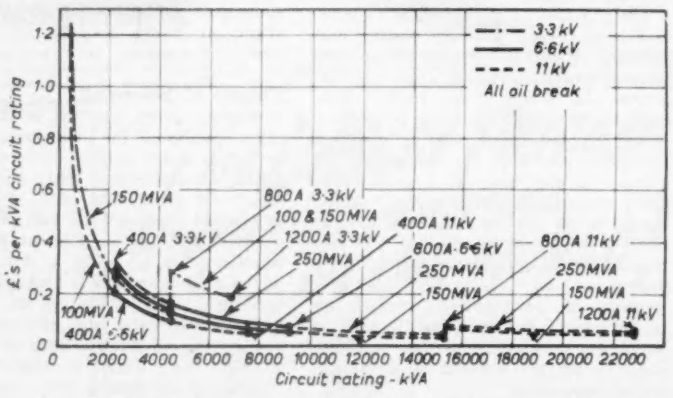

Fig. 2. Graph relating unit cost of primary voltage switchgear with circuit rating

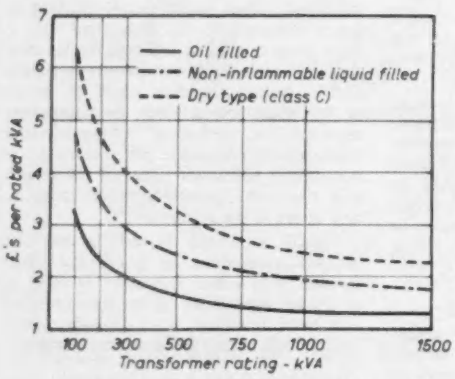

Fig. 3. Graph relating unit cost of transformers for different basic types

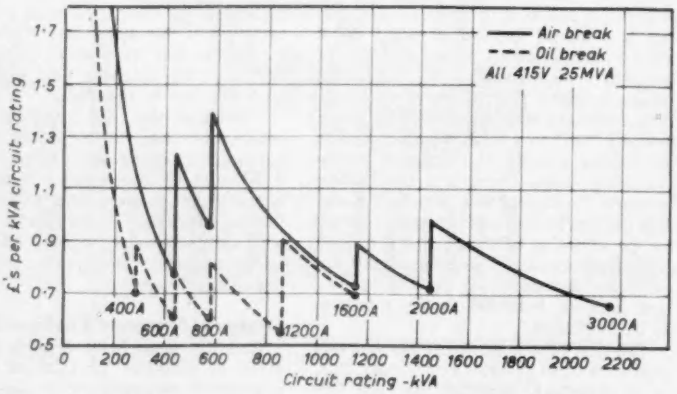

Fig. 4. Graph relating unit cost of secondary voltage switchgear with circuit rating

FOUR 500 MW SETS for EGGBOROUGH

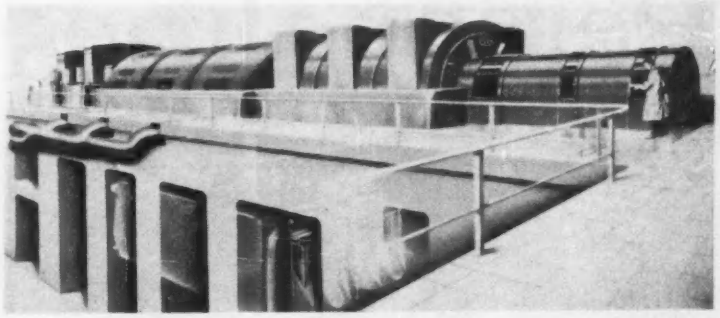

Fig. 1. Artist's impression of 500 MW AEI set

FOUR 500 MW sets and the associated boilers have been ordered by the CEGB for the Eggborough power station. This station is to be built on the River Aire, about four miles to the east of Knottingley, Yorkshire. The first unit is due for commissioning in 1966, and the station should be completed by 1968.

Turbo-generators for the station are to be supplied by AEI (£14 million contract) and boilers by the Foster Wheeler-John Brown consortium (£19 million contract).

Turbines

The tandem compound, single-shaft 500 MW sets being used are a later development of the 550 MW cross-compound double-shaft machines already being manufactured by AEI.

The turbines are to operate at subcritical steam conditions, 2,300 lb/sq in., 1,050°F at the turbine stop valve, with reheat to 1,050°F. The turbines are of five-cylinder design, and after the h.p. cylinder sufficient steam is extracted to supply a turbine of about 15,000 b.h.p. output for driving the main boiler feed pump.

The main turbines are divided into h.p., i.p. and three l.p. cylinders. The rotor of each cylinder is supported by two bearings and all rotors are solidly coupled. The cylinders as a whole are anchored to the foundations at the l.p. end, the rotor assembly being fixed relative to the cylinders by a thrust block at the h.p. end. Special precautions have been taken to accommodate the large differential expansion between rotors and cylinders necessarily involved in the long machine.

Steam exhausted from the h.p. cylinder passes to the reheater and returns to the turbine in the centre of the double-flow i.p. cylinder. The six exhausts are connected into an exhaust-piece to which the condenser is bolted. The condenser is arranged axially beneath the turbine. Design vacuum is 28·7 in. mercury at full load.

The turbine driving the boiler feed pump is arranged as a back-pressure machine, the exhausted steam being used for feed-water preheating.

Generators

The generator is designed for 22 kV generation and rated for 0·85 power factor, 0·4 short-circuit ratio. It is hydrogen-cooled at 45 lb/sq in. with direct water-cooling of the stator windings. To reduce transport weight, stator core and windings are built in a light cage, which is subsequently inserted in a gas-tight outer casing on site.

Excitation is provided by a direct-coupled, four-pole a.c. generator, the output of which is rectified by a bank of silicon rectifiers directly connected to the main generating slip-rings.

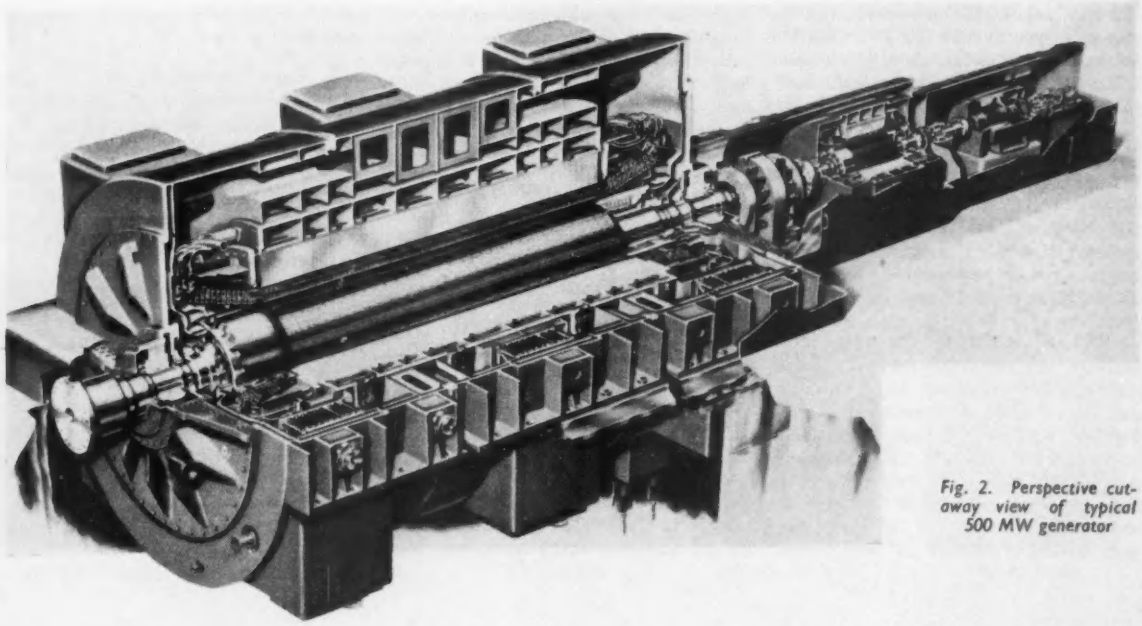

Fig. 2. Perspective cut-away view of typical 500 MW generator

Personalities *in the industry*

Sir William McFadzean

Mr R. M. Fairfield

Mr W. C. Handley

Mr M. L. Beswetherick

Mr K. Sutherland

Deputy works manager at Chapelcross establishment of the UKAEA since March, 1959, **Mr D. R. Fair,** B.SC.(HONS.), A.INST.P., A.K.C., has been appointed nuclear operations engineer with the CEGB at the Operations Department headquarters in London as from 8 Jan., 1962 (*ESH, page 48). He succeeds **Mr G. T. Shepherd,** B.SC.(ENG.), A.M.I.MECH.E., A.M.I.E.E., A.C.T.(BIRM.), who takes up his new duties on 1 Jan. as assistant regional director, Western Division, CEGB, as we exclusively reported on 21 Sept. After war service in the RAF, Mr Fair was a lecturer at the Royal Military Academy at Sandhurst until 1950 when he joined the UKAEA at Windscale. There he subsequently took charge of the Health, Physics and Safety Group and, in 1955, transferred to the Pile Group. From 1956 to 1959 he was assistant works manager at Calder Hall. In his new duties Mr Fair will lead the Nuclear Operations Branch in its work of co-ordinating with the Board's regional organisation, the commissioning, operation and maintenance of the CEGB's nuclear power stations, and giving operational advice on design, health and safety matters.

In view of the growth in the activities of the BICC group in recent years. **Sir William McFadzean,** C.A., COMP.I.E.E., in order to be free to concentrate on overall policy and the national and international aspects of group affairs, is at his own request relinquishing the office of managing director from 1 Jan., while remaining executive chairman. He will remain responsible to the board for supreme executive policy and overall co-ordination of the group, but will delegate the executive operation to **Mr R. M. Fairfield,** B.SC.(ENG.), M.I.E.E., M.I.MECH.E., F.A.I.E.E., and **Mr W. C. Handley,** B.SC.(TECH.), M.I.E.E., at present assistant managing directors, who will become joint managing directors. Mr Fairfield has been assistant manager of BICC since 1960, having joined the board in 1954 as director of production and engineering, and later as director (home operations). Mr Handley was appointed liaison officer, home group activities, to BICC in 1949 and joined the board of that concern in 1951, subsequently becoming assistant managing director. It is also announced that **Mr H. F. Akehurst,** at present assistant managing director, will become executive director (export) and **Mr W. Fraser,** B.SC.(HONS.)(ENG.), at present a director, is to be executive director (overseas companies), from 1 Jan., 1962.

Sales representative with Stearn Electric Co. Ltd. since 1953, **Mr M. L. Beswetherick** has now been appointed sales manager of their London Lamp and Lighting Department.

Miniature Electronic Components Ltd. announce the appointment of **Mr D. Laurie** as sales manager. A graduate in electrical engineering of Sheffield University he was a sales engineer with the Components Division of Standard Telephones and Cables Ltd. before joining MEC just over two years ago. MEC have also appointed **Mr P. B. Bullers** as their sales engineer for the north of England.

Joint managing director of Contactor Switchgear Ltd. since 1957, **Mr A. W. Lawry,** A.M.C.T., A.M.I.E.E., is now managing director of the company, following the retirement of **Mr J. F. Liwiski.** The latter has agreed to act as a consultant to the board. Mr Lawry has been a director of the company since 1949 and was, earlier, with the Electrical Apparatus Co.

Mr K. Sutherland, M.C., M.E.E., M.I.E.(AUST.), who retired as engineer and manager of the Electricity Supply Department of the State Electricity Commission of Victoria, Australia, on 9 Dec. (as we intimated on 30 Nov.), was one of the pioneer engineers of the Commission. He was the guest at a farewell dinner recently, which was attended by the chairman and commissioners of the SEC, and over 90 present and past senior SEC officers. The originator of the successful "self-help" finance plan for financing electricity supply extensions, Mr Sutherland was engineer and manager from 1949. During that period the final phase in the electrification of rural Victoria has been more than half completed. He joined the Commission as an assistant engineer in the Electric Supply Branch (as it was then known) in 1921. For the next five years he was closely associated with early power surveys of Victoria and the construction of Victoria's first h.v. transmission line. From 1926 to 1931 he was district manager at Gippsland and, returning to Melbourne, he was electrical development manager for over 15 years. Mr Sutherland's successor is **Mr K. L. Murray,** A.M.I.E.(AUST.), who joined the Commission in 1924 and has been assistant engineer and manager since 1959.

Sir John Macpherson, who was the first Governor-General of the Federation of Nigeria, and subsequently for three years Permanent Under-Secretary of State for the Colonies, has been appointed chairman of Cable and Wireless Ltd. and its associated companies as from 1 Jan. next. He succeeds the late Sir Godfrey Ince.

Mr C. M. Banks has joined the Systems and Applications team of the Automatic Business Equipment group of Ultra Electronics Ltd.

George Kent Ltd. have appointed **Mr R. C. Ingram** to the newly created post of marketing manager. For the past ten years he has been a technical sales rep-

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**Denotes revision to the "Electricity Supply Handbook, 1961."*

resentative, first for Yorkshire and then Middlesex. Mr Ingram, who is 44, joined the company as a student apprentice in 1934, and became a service engineer in north east England on completion of his training. He later became manager of the first Nuclear Section of Production Control, which was responsible for the supply, erection and commissioning of the instrumentation for Harwell's first large-scale reactor and, later, for equipping both reactors at Windscale.

Mr G. E. Gathercole has been appointed first vice-chairman of the Hydro-Electric Power Commission of Ontario. He was formerly deputy minister of the Department of Economics and Development.

Formerly sales manager of Technical Ceramics Ltd., **Mr F. A. Ramage,** A.M.BRIT.R.E., has joined Electro Mechanisms Ltd. as technical sales manager.

Mr R. L. Jeanes, senior assistant engineer in charge of the system operation and maintenance department of the Coventry sub-area of the East Midlands Electricity Board, has retired after 45 years' service in the electricity supply industry. At a dinner to mark his retirement, Mr Jeanes was presented with an electric radiator by Mr S. G. Wood, sub-area engineer, on behalf of his colleagues in the mains department. He was also presented with a silver tea service on behalf of all the employees in the Coventry sub-area.

Mr A. A. Conway has been appointed sales promotion manager of "Servis" domestic appliances. He has previously held the position of London sales manager for the "Servis" Home Sales Division.

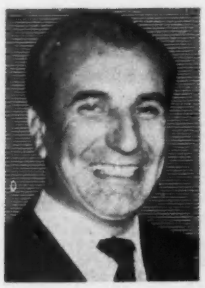
The appointment of **Mr W. Atkinson Adam,** M.I.MECH.E., as managing director of the three British Divisions of the Yale and Towne Manufacturing Co. has been announced. Mr Adam gained his early practical training at several well-known British engineering firms and, after war service, including service on the staff of the Royal Naval Engineering College at Plymouth, became chief engineer with John Summers and Sons Ltd., for their works in Argentina, the Anglo-Argentine Iron Co., at Buenos Aires. Having reached a senior managerial position in engineering, he resigned to develop his marketing experience and, in 1951, joined G. and J. Weir Ltd., of Glasgow, as managing director of its French, and, later, Belgian and Dutch companies. In 1959 Mr Adam set up a new engineering, marketing and manufacturing business in Holland in association with Dutch interests—Adam-Hodge N.V. In order to accept the Yale and Towne appointment he has resigned his executive responsibilities with this company, but will continue to serve on the board of directors.

Mr Frank Haxell, the former general secretary of the Electrical Trades Union, has been removed from the board of the Specialist Trades Holiday Scheme Ltd., which administers holiday arrangements in the electrical contracting industry. **Mr J. T. Byrne,** the present general secretary of the ETU, has been nominated to succeed him.

After nearly 32 years' service with Hoover Ltd., **Mr A. W. Bunn** has retired from the positions of deputy general sales manager (home) and field sales manager. **Mr P. A. D. Duffell** who was, until recently, manager of the

Council and Regional Changes

Regional director of the North Eastern Region of the CEGB since January, 1958, **Mr P. Briggs,** A.M.I.MECH.E., M.INST.F., has been appointed a full-time member of the Electricity Council for a period of five years from 1 Jan. next (*ESH, pages 45, 70). Mr Briggs will have special responsibility for industrial relations, reporting to the chairman. **Mr C. T. Melling,** C.B.E., M.SC.(TECH.), M.I.E.E., M.I.MECH.E., M.INST.F., who has hitherto been responsible for industrial relations, became a deputy chairman of the Council on 1 Aug. last, and has, therefore, taken over the technical duties discharged by his predecessor, Sir Josiah Eccles. The successor to Mr Briggs as regional director of the North Eastern Region, from 1 Jan., is **Mr C. G. Richards,** M.SC.(TECH.), A.M.I.MECH.E., A.M.I.E.E., who was previously deputy regional director there, and the latter position is being taken over by **Mr W. Wilde,** B.SC.(ENG.), M.I.MECH.E., M.I.E.E., M.INST.F., who has been assistant regional director, South Wales Division of the South Western Region (*ESH, pages 64, 70). Prior to 1958 Mr Briggs was divisional controller of the Yorkshire Division from 1957 after holding a similar position with the Merseyside and North Wales Division from January, 1953. Earlier he had been chief generation engineer (operation) to the South Eastern Division of the BEA, from 1948. Mr Briggs received his engineering training in the workshop, drawing office and test department of Peter Brotherhood Ltd. From 1925 to 1929 he was charge engineer at Islington power station, and then went to the old Fulham power station in the same capacity. Successively he held positions of assistant operating engineer, maintenance superintendent in the new Fulham station, and then power station superintendent from 1945 to 1948. Mr Richards began his career with Metropolitan-Vickers, and after a period on the outside erection staff joined the Singapore municipal undertaking in 1931 as power station engineer, ultimately becoming distribution engineer. From 1945 to 1948 he was generation engineer with Sheffield Corporation Electricity Department, and at vesting date was made chief generation engineer (operation) of the Yorkshire Division. He has been divisional controller of that division since 1958. Mr Wilde started with the Sheffield Corporation undertaking, where he held several engineering appointments at Blackburn Meadows and Neepsend power stations. After a period with the Newcastle upon Tyne Electricity Supply Co. he joined the Lancaster Corporation as charge engineer, and in 1926 became combustion engineer with the London Electric Supply Corporation at Deptford East station. In 1948 he was appointed generation engineer (operation) of Group II of London Division's power stations, later becoming chief generation engineer (operation), London Division, where he remained until given his last position in 1958.



Mr A. A. Conway

Mr W. Adam

Mr P. Briggs

Mr C. G. Richards

Mr W. Wilde

Hoover organisation in Germany, has taken over the position of field sales manager.

Mr J. C. George, C.B.E., M.P., Parliamentary Secretary to the Minister of Power, last week visited the headquarters of the Midlands Electricity Board at Halesowen. He is seen here, left, being welcomed by the Board chairman, Mr W. S. Lewis, right, and Mr G. F. Pierson, deputy chairman, who will succeed Mr Lewis as chairman on his retirement on 31 Dec.

Mr A. Cole has joined the Mining Department of GEC (Engineering) Ltd. at the company's Fraser and Chalmers works at Erith. He will maintain contact with mining companies and commission GEC mining plants in the UK and overseas.

Mr H. C. Mayer, F.A.C.C.A., executive director and secretary of Griffin and George Ltd. and its subsidiaries, has been appointed deputy managing director of the group.

The Minister of Power has re-appointed **Mr B. Pickup,** C.B.E., J.P., as a part-time member of the North Western Electricity Board. **Mr G. A. Howe,** M.A., LL.B., F.C.A., retires from part-time membership of the Board on 31 Dec., 1961 (*ESH, page 155).

Formerly efficiency engineer at Pyrmont power station, **Mr K. S. Watson** has been promoted to engineer, generation investigations, in the Projects Division for the New South Wales Electricity Commission.

Mr J. A. Fitzpatrick has been appointed northern area manager at Manchester of Cape Insulation and Asbestos Products Ltd., subsidiary of the Cape Asbestos Co. He succeeds **Mr J. F. Callaghan,** who retired on 1 Dec. after 41 years' service.

Belling and Lee Ltd. announce that **Dr A. C. Robb,** M.ENG., PH.D., A.M.I.E.E., formerly technical manager, has been appointed technical director, and **Mr J. R. Turrill,** formerly sales manager, becomes sales director.

Previously with W. S. Atkins and Partners as a design engineer, **Mr Brian D. Hughes** has joined Crompton-Parkinson (Stud-Welding) Ltd. as special projects engineer.

The end of this month brings the retirements of **Mr A. Haselhurst,** A.A.C.C.A., A.C.W.A., chief commercial officer of the Yorkshire Electricity Board, and **Mr C. Booth,** M.I.E.E., manager of the Board's No. 2 (Huddersfield) sub-area. Mr Haselhurst has been chief commercial officer from 1948, following seven years as commercial manager and deputy chief official of the Bradford Corporation undertaking. Mr Booth was engineer of the No. 5 sub-area before taking up his post at Huddersfield in 1952. Prior to 1948 he was borough electrical engineer at Dewsbury for two years.

OBITUARY

Mr L. Edgar, publicity manager to the John Thompson group, died recently.

Mr L. R. Piper, representative in Scotland to the Midland Electric Manufacturing Co. for the past 32 years, has died.

Mr J. H. Norman, Croydon depot manager to Kerry's (Gt. Britain) Ltd., has died.

Materials for Electrical Design

ULTRA-HIGH-TEMPERATURE FOAM

A FINE grained silica foam material, said to be suitable for working temperatures of up to 2,000°F, is now available in the UK under the trade name "Eccofoam SI." An American development originating from Emerson and Cuming, it is available in sheet form 6 in. by 6 in. by ¼ in. or in multiples of this size. The grain structure is exceptionally fine, the cells being less than 100 microns in diameter, and it can be glazed to make it impervious to water. It can easily be machined and can be bonded to itself or to other materials by Eccoceram WL-52 ceramic adhesive. *Microcell Ltd., Electronics Division, Herga Hse, Vincent Sq, S.W.1.*

STRONGER MYLAR

FIVE new grades of Dupont Myler (Polyethylene terephthalate) film with enhanced tensile strength are now available here. Three, 50T, 75T and 100T, have a tensile strength of 40,000 lb/sq in. 45% ultimate elongation and 11% shrinkage at 150°C. The others, 300 No. 501 and 500 No. 501 have tensile strengths of 35,000 lb/sq in. MD and 10,000 lb/sq in. transverse, 50% elongation MD and 300% transverse and 14% shrinkage at 150°C. Both types are available in widths of up to 24 in. and the initial figure gives the thickness of the film in in. x 10^{-5}. For example, 100T is 0·001 in. thick. *Durham Raw Materials Ltd., 1-4 Gt Tower St, E.C.3.*

VERMICULITE BOARDS

TWO new fire-resisting boards containing vermiculite in the exfoliated form are now available which are specially designed for use in buildings where the ordinary grades of fibreboard are not acceptable on account of fire risk. The first is a woodfibre/vermiculite composition designed to conform with the requirements of BS 476:1953, Class 1 and is claimed to be the first material for board manufacture to be integrally flameproofed during fabrication. It is in production as "Sundeala" flameproofed fibre building board.

The second, not yet in production but shortly expected to be available, is a vermiculite/asbestos/cement/woodfibre composition which is, for all practical purposes, non-combustible. It will withstand 900°C to 1,100°C indefinitely and will not disintegrate when subsequently immersed in water. Inexpensive to manufacture, it can be cut, nailed or screwed and gives normal insulating board performance in other respects. *Mandoval Ltd., Research and Development Division, 94b Balham High Rd, S.W.12.*

BERYLLIUM METAL

UNTIL recent times classified as a "rare metal," beryllium is now becoming a widely used metal in many spheres. It is in fairly large-scale production in the UK by the Consolidated Beryllium Co. Ltd. at Avonmouth with a sister factory at Milford Haven for preparing beryllium oxides and ceramic ware. The metal is extracted from imported beryl ore, containing about 4% beryllium, as beryllium oxide which is converted to beryllium fluoride after which the pure metal is extracted by thermal reduction with magnesium.

Beryllium has a fairly high melting point—above 1,280°C—and a low density which, at 1·85, is about 30% lighter than aluminium and only slightly above that of magnesium. The u.t.s. is exceptionally high, rising to 90,000 lb/sq in. in the hot extruded and annealed form. Other properties and useful information are listed in the new booklet, *Beryllium—The New Light Metal,* recently published by the company. *Consolidated Beryllium Ltd., 6 St. James's Sq, S.W.1.*

PROTECTION BY PHOSPHATING

A NEW room-temperature phosphating process, "Fospryme," provides a simple and effective method of protecting steel against corrosion either before fabrication or prior to final finish.

"Fospryme" phosphating solution can be applied by spray-gun, brush or roller or even by a simple dipping process to the degreased surfaces after which it dries off naturally ready for the application of the finishing coats without the necessity of rinses. Being self-sealing, it gives a high degree of protection during fabrication but does not interfere with normal welding or machining operations "Fospryme" can be supplied in 1 gal to 10 gal cans and in a range of colours for easy identification. *Hellermann Ltd., Gatwick Rd, Crawley, Sussex.*

Linear motors and generators

OSCILLATORY MOTION DERIVED FROM A.C. AND D.C. FIELDS

A QUESTION which has long troubled philosophers is whether man's invention of the wheel is really as important as it is claimed to be, since nature makes no use of it at all. Is it not possible that, in his preoccupation with making "things go round," he is tending to neglect development of linear and oscillating mechanisms which are not derived from rotary motion in the first case? In at least one quarter, Manchester University, the subject is receiving close attention by Dr Laithwaite, M.SC., PH.D., A.M.I.E.E., and his colleagues, with results which are already quite promising.

On Thursday last, at a meeting of the Utilisation Section of the IEE in London, a paper* by Dr Laithwaite and R. S. Mamak was presented, in which progress made with the design of an oscillating synchronous linear machine was described. The larger part of the evening, however, was given over to a most entertaining and instructive lecture by Dr Laithwaite on his experiences since he first took up the study in 1946.

He described the first experimental machines devised to provide an electrical means of oscillating the shuttle through the loom in weaving machines. Though apparently soundly based in theory, they failed to work for one reason or another and, as each difficulty was overcome, so knowledge increased and concepts changed, until a fairly sound pattern of behaviour emerged. For the most part they were basically a.c. multi-phase machines derived, in principle, from the conventional circular three-phase stator cut across at one point and laid out flat, the rotor —now an oscillator—being an equally conventional magnetic inductor.

One way of classifying these devices is to divide them into two groups, moving-iron and moving-conductor, the former being analogous to conventional rotary machines in which both iron and conductor move together. In the latter, only the conductor system moves. The simplest form of moving-iron system comprises a laminated iron block making and breaking a magnetic circuit, through which flux is produced by a permanent magnet or a d.c. coil. This is a linear counterpart of the rotary inductor alternator and, like it, cannot make full use of the flux. The linear counterpart of a conventional synchronous machine is one in which the magnet or d.c. system is carried on the moving member and this, too, is subject to the same limitation. In both cases the considerable mass of the moving part is a distinct disadvantage in an oscillating machine which has to accelerate, retard and reverse the mass many times a second, involving heavy stresses on the driving mechanism. On the rotary machine, this disadvantage does not exist; in fact, in some cases it may be a positive advantage.

Moving Conductor Systems

The simplest form of moving-conductor system is one in which the conductor alone is oscillated across the gap between two magnet poles. A single-turn conductor may have good rigidity but the voltage generated will be low. Increasing the turns raises the voltage but reduces the rigidity. The first stage of development is to make the moving turns the primary of a step-up transformer which, itself, remains stationary, and the second step is to insert the transformer core within the field magnets and at right-angles to it, with a single solid loop oscillating between so as to embrace the centre limb of the transformer core—of which it is the primary winding—and alternate poles of the magnet system as it moves back and forth.

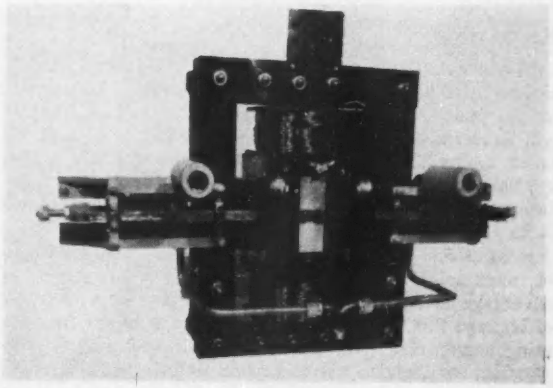


Fig. 1. An experimental model of the linear motor/generator described by Dr Laithwaite

By this arrangement, the mass of the moving part, the solid single-turn loop, may be kept down to reasonable size, but there are other disadvantages. The turn must be larger than the transformer core in one dimension to allow for the oscillation and this introduces extra resistance and leakage reactance. Moreover, it increases the size of the machine.

Final Development

In the arrangement referred to, there are two separate magnetic systems. They can be combined into a single common magnetic system carrying both d.c. and a.c. coils by arranging them as in Fig. 2. The loop is now encircling the central limb and moves in the relatively small gap between the limb and the adjacent pole-pieces. It need not, therefore, be any larger than is required for mechanical clearance nor need it be insulated. It will, in fact, operate red-hot if need be without affecting the performance of the machine materially.

The loop A moves up and down (or along, according to how the machine is oriented) the centre limb, being attached to the prime mover by the arms F and G. Windings on this limb, D and E, carry the a.c. coils, while those on the pole-pieces, B and C, are the d.c. exciting coils. As the loop moves across the d.c. field, current is generated in it which reverses with the change of direction of the motion. This current supplies the magnetisation

* Paper No. 3351. "An Oscillating Synchronous Machine."

to the central limb containing the output winding. Since the current reverses in the loop, the flux in the central limb and current in the output windings will alternate.

The arrangement is compact and is shown in prototype experimental form in Fig. 1. It contains all the essentials of a conventional alternator and a transformer, but the outer core of the machine must be large enough to accommodate both d.c. and alternating fluxes superimposed without reaching saturation and, like all alternators, it displays armature reaction effects. Having both leakage reactance and internal resistance, it may be allocated a synchronous impedance in the usual way.

Regulation

In the ordinary way, synchronous impedance is likely to be rather high. If nothing is done to make the current in the loop flow uniformly—and it is unlikely that it will inherently—the a.c. resistance of the loop will be much higher than its d.c. resistance. One way of rectifying this is to insert a conducting grid in the d.c. pole-faces; another is to lay conducting sheets across the pole-faces. The paper discusses how the use of either of these devices affects flux distribution. The d.c. pole-pieces could be made solid, but it is doubtful as to whether this is an advantage for, though they would restrict the penetration of leakage flux, a greater loss would be incurred than by using copper-clad laminated pole-pieces and the problem of attaching them to the laminated outer structure would offset the lower cost, if any. The loop itself may be made of copper or aluminium.

Multi-polar Constructions

In Fig. 2 are two methods of modifying the d.c. pole-pieces to give effective four-pole operation. It can be seen that reversal at each end of the stroke causes one reversal of the induced current in the loop and another in the centre of the stroke. Sinusoidal wave-form can be ensured by proper proportioning of the pole-faces. Similarly, by suitable arrangement of the pole-faces, six-, eight-, ten- or other multi-pole operation can be achieved with corresponding doubling-up of generated frequencies for the same speed of oscillation.

One advantage for this arrangement is that the d.c. magnet system is self-contained and only the centre section carries both d.c. and a.c. flux. On the other hand, it has the same disadvantages as in a conventional multi-pole machine, a loss of power/weight ratio and efficiency.

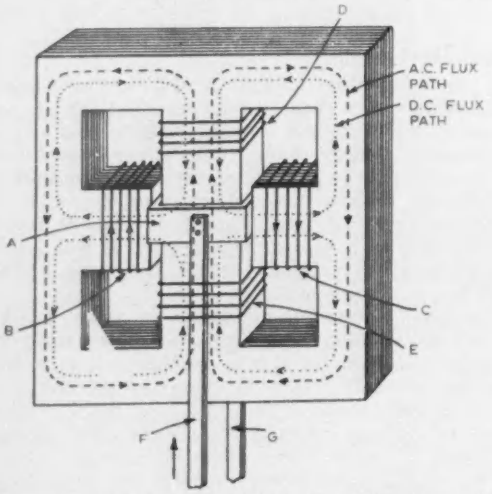


Fig. 2. Diagrammatic construction of the linear machine shown in Fig. 1

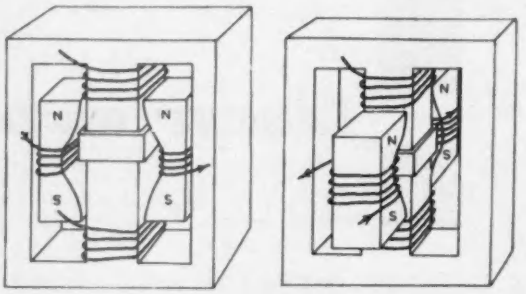


Fig. 3. Four-pole forms of the linear machine. Left, co-planar and, right, cruciform construction

The experimental machine shown in Fig. 1 is a two-pole structure which was shown during the lecture, and this was used to determine the performance of the device both as a generator and motor. It was made from the most readily available steel and it is appreciated that the core length was much too short in relation to the width of the d.c. pole-pieces to give a high output and efficiency. The paper discusses the results of tests with different flux levels in the coils when the machine was used as a generator, the loop being driven from a Scotch yoke oscillated by a d.c. motor to give a sinusoidal motion.

On the basis of the figures obtained, criteria were established and figures of performance, dimensions, weight and size determined for a reasonably well-designed machine in accordance with the basic form discussed. The machine would have an output of 150 A at 220 V—that is 33 kVA—and the overall dimensions would be 27 in. by 26½ in. by 36 in. The amplitude of oscillation would be 3 in. and the approximate weight 6,000 lb.

Operation as a Motor

The prototype also operates as a motor and, in fact, it was in this guise that it was demonstrated. Unlike the rotary synchronous machine, it is self-starting, the amplitude building up to a stable value set by the d.c. flux, applied a.c. voltage, frequency and load. On this basis, it could be assumed that the 33 kVA generator operating as a motor would produce some 40 h.p. Moreover, the motor is capable of drawing leading current from the supply in the manner of a Kapp vibrator and can, therefore, be used for power factor corrections. Strangely enough, the self-starting properties of the linear motor are destroyed if it is coupled to a crank to produce rotary motion, since the moving loop is called upon to make the first stroke at full amplitude. This it cannot normally do.

Discussion

Perhaps, because of the time of the year, the attendance was rather light and, as a result, the discussion was somewhat limited. Professor Tustin made a number of suggestions which he thought might improve performance. These included the provision of slots in the pole-pieces to suppress flux leakage, and even a moving loop comprising alternate sections of copper and iron. Dr Laithwaite, replying, agreed that the points were worth considering, but the inclusion of iron in the oscillating loop was a matter of scale. On machines at present envisaged, advantages and disadvantages might well cancel out.

Finally, Dr Laithwaite disclosed that he had recently translated some writings of the French scientist Boucherot at the turn of the century, to find that almost everything that he had done had been anticipated in principle half a century ago, a rather humbling thought.

Pantograph test train for B.R.

NEW UNIT FOR SERVICE ON EASTERN REGION

AS a result of experience already gained on those electrified lines in service, the standard of current collection from overhead lines by pantograph equipment on British Railways is commendably high. That is not to say, however, that it is incapable of being improved, at least on some sections of the line, nor that, without constant monitoring and maintenance, the standard would be maintained.

This research is a subject dear to the hearts of both the instrument and control department of the BICC research organisation and to the chief mechanical and electrical engineer's department of the Eastern Region. In order that a study of performance of collecting gear can be made at speeds up to 100 m.p.h., a new pantograph test train has been developed and put into service on those lines which have been, or are being, electrified in the Eastern Region.

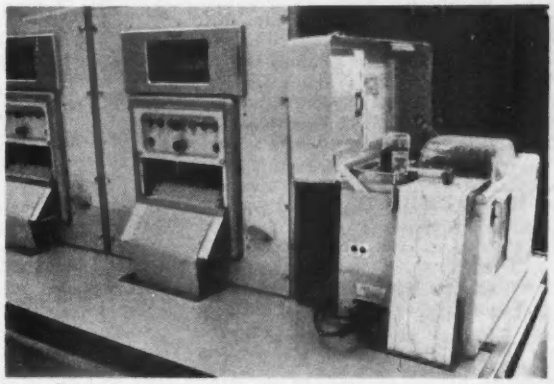
In many respects the unit is similar to that which BICC developed in conjunction with the London Midland Region last year and which was described in the ELECTRICAL TIMES of 10 March, 1960 (page 391), but it naturally includes improvements in detail arising out of experience with the earlier unit.

The Coach

The coach is a converted passenger vehicle which was modified at the Doncaster Carriage Works to take a central observation dome in the roof and two Stone Faiveley Type AMBR pantographs. One of these is "live" insulated for 25 kV; the other is "dead" for use with earthed overhead line and with the coach being hauled by a diesel locomotive. The latter is insulated for 300 V d.c. and will be used for checking loss of contact at high speeds between overhead line and pantograph. The "live" pantograph incorporates a glass-fibre linkage coupled to strain-gauge type accelerometers for recording head accelerations, a linear potentiometer for monitoring pantograph height and strain-gauge ring dynamometers for determining contact pressure.

Instrumentation

Inside the coach the instruments are, for the most part, concentrated in an instrument panel 12 ft long by 6 ft

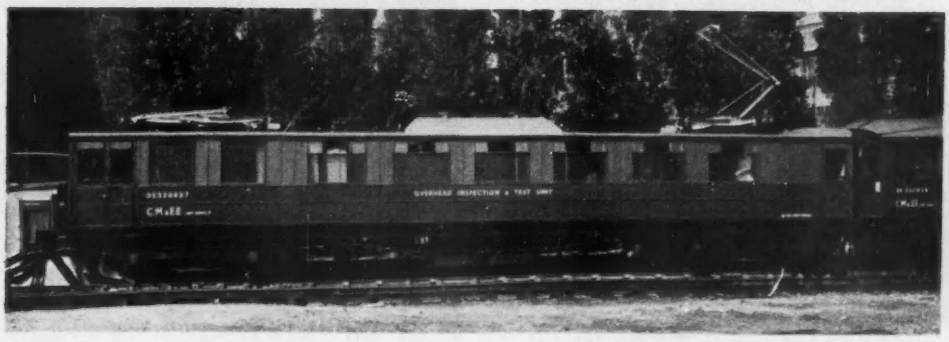


View of the recorder panel on the pantograph test train showing high speed and low speed recorders

high mounted below the "'dead" pantograph, and here are to be found the instruments for indicating and recording pantograph height, acceleration, contact loss, contact pressure, speed, traction current, etc. and, on the recorders —there are four, one high-speed, four-channel and three low-speed, two-channel—track and timing marks can be inserted during running. Chart speeds are proportional to train speed and recordings are made on a distance basis.

Beneath the "live" pantograph in the coach is the high-voltage cubicle, which houses the instrument transformers for measuring overhead line voltage and current. Here also are arrangements for providing current to the electric traction locomotive when drawing the test coach with its own pantograph down so as not to disturb the overhead line. Power for instruments, lighting and heating, as well as compressed air for operating the pantographs, is provided from an adjacent generator coach.

The new unit will be used on the Liverpool Street-Southend line and the recently completed Fenchurch Street-Southend line, as well as for maintenance check on the north east London lines completed in 1960. It will also be used to check the overhead equipment on the Chelmsford-Colchester and Liverpool Street-Clacton-Walton lines when they come into service.



The new pantograph test train which has been jointly developed by BICC and BR engineers for service on the Eastern Region

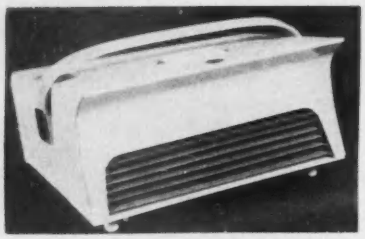
new products and appliances

Sensitive c.r. tube

RECENTLY announced is a new 5 in. helical cathode-ray tube with post-deflection acceleration to give high sensitivity. Deflection sensitivity in the x direction is 32 V/cm and in the y direction 10·5 V/cm with a gun voltage of 1,670 V and a final anode potential of 10 kV. Line width is approximately 0·4 mm and the overall length of the tube with glass base is 43·9 cm. Known as the 1300G tube, it has a scan size of 10 cm by 6 cm. *The M-O Valve Co. Ltd., Brook Green, W.6.*

German fan heater

NOW being imported from West Germany is the "Haltron" turbo-fan heater. A lightweight model, it is supplied with a carrying strap. Maximum loading is 2 kW and it has two fan speeds, and elements are controlled at 1 kW and 2 kW by four rocker switches. The six combinations, fan and heater, are claimed to make the appliance versatile for both heating and cooling. It operates on standard voltages and carries the usual 12-month guarantee. Finish is in neutral grey and the fan heater sells at 9½ gn. *Distributors: Hall Electric Ltd., Haltron Hse, Anglers La, N.W.5.*



Imported from Germany is the "Haltron" fan heater

Potato cooker for farms

RECENTLY developed is a potato cooker for use on farms, which is designed to make use of off-peak tariff rates. The trolley tank, which is fully insulated, will hold a maximum of 4 cwt of potatoes and cook them overnight for pig fodder. It uses a 3 kW immersion heater with thermal cut-out. Called "Tatakuka," this unit has a draining device for water and sludge and is mounted on three wheels for manoeuvrability. It is priced at £68. *Whitlock Bros. Ltd., Gt. Yeldham, Essex.*

Precision temperature control

MAINTAINING precise regulation of industrial process temperatures, an electronic automatic control system is claimed to be sufficiently sensitive to correct a change of only half a microvolt representing a temperature deviation of one-fortieth of a degree F. Three separate units make up the system, a set-point unit, deviation amplifier and control station connected to the process under control so as to form a closed loop circuit. Essentially the set-point unit generates a millivoltage equivalent to the desired control temperature to oppose the millivoltage generated by the thermocouple located at the process under control. Difference in millivolts between the set-point and thermocouple is then presented as an error signal to the deviation amplifier which amplifies this signal to give a d.c. output of ±4 V maximum. After indication on a centre zero meter, the amplified error signal is passed to the control station which provides a corresponding control signal of up to 5 mA. An independent current source may be provided at this stage to give manual control of the process temperature. By means of a magnetic amplifier, the small control signal is then raised to a level high enough to control a saturable reactor, usually 0-75 V d.c., which in turn regulates power to the heating elements. All units are designed for operation from 120 V 50 c/s or 60 c/s supply, two set-point units being available covering an output range of 0-40 mV. *Honeywell Controls Ltd., Greenford, Middx.*

Earth borer speeds pole footings

ERECTION of wood-pole overhead lines is simplified by the use of a portable earth-boring machine designed for two-man, four-hand operation. Boring power is provided by an air-cooled two-stroke engine through a robust gearbox and via a centrifugal clutch which automatically disengages at idling speed, picking up the load as the throttle is opened. Tubular-steel rods are attached one by one between the auger and the machine to give boring depths up to 30 ft, though for the erection of overhead line poles, only one 5 ft rod would be necessary. For soil conditions where the raising of the auger by hand would be difficult, withdrawing gear can be supplied which may be quickly assembled. The borer may be also used for drilling under roads and embankments when mounted horizontally on a special carriage. Holes from 4 in. dia to 12 in. dia can be bored and it is claimed that time taken to drill a 4 in. dia hole 10 ft deep under ideal soil conditions is only 15 min. Engine sizes of 4½ h.p. to 8 h.p. and rods of various lengths are available according to requirements. Weight is 90 lb. *Earth Boring Machine Co., Lake Wks, Portchester, Hants.*

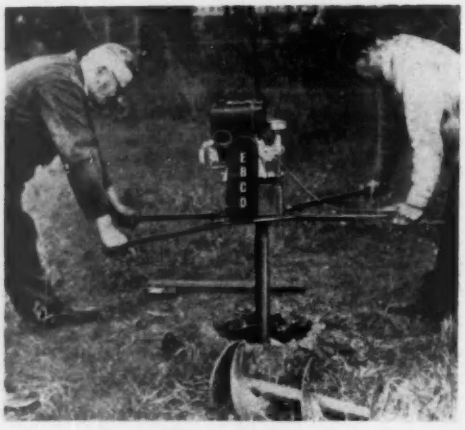


Fig. shows the portable earth boring machine in use. It can bore to depths up to 30 ft

Heating panels

JUST anounced by Pye are heating panels which can be used to build up a central heating system. Called "Rayglass," the panels have graphited glass-fibre elements compressed between non-metallic panels. The element extends over the whole area of the panel, diffusing heat evenly. Units are available separately, and individual panels as well as complete systems can be controlled by thermostats or time switches. Prices range from £6 8s 2d for a 300 W panel 24 in. by 23 in. to £8 12s 8d for a 500 W panel measuring 24 in. by 36 in. A towel rail version can be supplied for bathrooms and this, like the other panels, is said to require no earthing.

Pye have also introduced an air purifying hood to fit above the hobs of cookers. It utilises a small fan to draw odours over activated charcoal. Costing 28 gn. It incorporates a strip light. *Pye Electric Ltd., 9 Upper Berkeley St, W.1.*

Lagging jacket

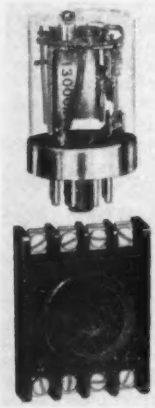
INTRODUCED this week is a new lagging jacket for hot-water cylinders. They are tailor-made in heat resistant plastics in white, red or maroon. The jackets conform to BS 1304 and are filled with "Slagbestos" mineral wool. Jackets are supplied complete with plastics fixing bands and are said to take only a few minutes to fit. Sizes are available for all sizes of cylinders and prices range from £1 15s to £4 16s 6d. *F. McNeill and Co. Ltd., 10 Lower Grosvenor Pl, S.W.1.*

Electric scissors

RECENTLY introduced to this country from America are electric scissors which are operated by a push-button switch. They are light, weighing only 6 oz, and shaped to fit the hand. The scissors can be used right- or left-handed and have plated high carbon steel blades. Outer casing is of plastics and a range of four colour finishes is available. Supplied with 10 ft of white cable, the scissors are 5⅛ in. long, 2 in. high and 1¼ in. wide. They are known as the "Thor Speed Snips," and are priced at £3 10s net. *Thor Power Tool Co. Ltd., 34 Victoria St, S.W.1.*

Plug-in relay reduces soldering

AVOIDING use of solder terminals, the new "Guinea" general-purpose mains relay is designed to plug into an octal socket which in turn is connected to external circuits by screw terminals. The relay has two change-over contacts rated at 5 A, 250 V and an operating coil for a.c. or d.c. voltages. Contacts are of silver cadmium oxide, which is claimed to give longer life because of its arc suppressing properties. On removal of the plastics cover, access is given to the contacts for cleaning purposes, and tension of the armature spring may be adjusted by means of a screw. For use in situations where vibration may be experienced, a retainer consisting of a cap with two springs may be used to secure the chassis of the relay to the socket. Sockets can be flush or through-panel mounted, with terminals that are accessible from back or front, each taking up to two 3/·029 in. cables. Relays are available for a.c. coil voltages, ranging from 6·3 V to 250 V, and for d.c. voltages between 9 V and 125 V. Hermetically sealed versions are also made with metal covers and filled with dry nitrogen. Price in quantities over 12 is £1 1s, sealed relay £2 2s. *D. Robinson and Co. Ltd., 5-7 Church Rd, Richmond, Surrey.*



Display cards

MORPHY - RICHARDS are now supplying display cards for their two "pop-up" toasters and the hairdryer. The cards for the toasters take the form of chefs holding slices of toast and will fit in the aperture at the top of the appliances. The display stand for the hairdryer shows the head of a girl with the dryer pointing at the hair.

Cell for transistor radios

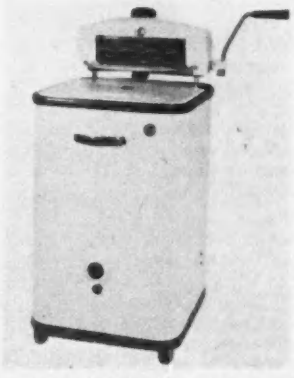
A 1½ V dry cell, especially for use in transistor radio sets and tape recorders, has been announced. It is of leak-proof construction and the cell weighs 1½ oz. Known as Type T19, it retails at 7½d and is available in display cartons containing one doz cells. *Chloride Batteries Ltd., Exide Wks, Clifton Junction, Manchester.*

Silicon rectifiers for high power

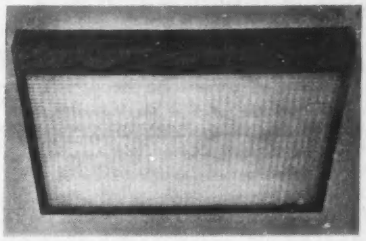
HIGH safety factor silicon rectifiers recently introduced by Mullard have now been made available in reversed polarity versions in which the casing may be made positive or negative. Construction of bridge rectifiers is now possible with only two heat sinks. Using diodes of opposite polarity mounted on the frames of exciter motors, chassis or cabinets, a choice of either a positive or negative earth is available. Rectifiers are claimed to have high safety factors, which reduce the need for elaborate protective fusing and surge limiting when operated in parallel. Although rated for a maximum forward current of 20 A, all four types will withstand a forward current of 600 A for 10 millisec. Type BYZ15 (reversed polarity version of BYZ14) is rated for a maximum repetitive peak current of 100 A. Maximum repetitive peak inverse voltage is 200 V and the maximum allowable surge voltage 400 V. Four of these rectifiers, when connected to form a single-phase bridge, give a maximum forward current of 40 A at 250 V d.c. Type BYY16 (reversed polarity version of BYY15) is similar to the BYZ15, except that the maximum repetitive peak inverse voltage is 400 V and the maximum allowable surge voltage 800 V. *Mullard Ltd., Mullard Hse, Torrington Pl, W.C.1.*

Dutch washing machine

INTRODUCED recently is a new version of the "Fam" washing machine which is manufactured in Ireland by a Dutch company. It has a capacity of 4-5 lb dry wash and uses a 2 kW heater. The "Fam" uses a pulsator action and has an automatic time switch. It is suitable for standard voltages and is powered by a 500 W motor. Heavy gauge rust-proofed steel is used for construction and the washing machine is finished in white stove enamel with blue trim. This machine is priced at 29½ gn including tax and a 12 in. wringer costs 5 gn. *Importers: Couper Electrical Sales Ltd., 17 Finsbury Sq, E.C.2.*



The redesigned "Fam" washing machine



Designed for boardroom and similar use is Merchant Adventurers' oiled teak fluorescent fitting

Teak fluorescent fittings

INTENDED for use in boardrooms and offices of higher executives are a range of fluorescent lighting fittings from Merchant Adventurers. The fittings are finished in oiled teak and can be supplied as ceiling or pendant mountings. They are available in four sizes ranging from 2 ft by 2 ft to 5 ft by 2 ft, with a maximum of six 80 W lamps. Light is directed downwards through a precision moulded louvre with a 45° cut-off. Controlled upward illumination provides a modicum of ceiling lighting. For ease of maintenance, the teak frames hinge downwards from either side. These fittings will be available early in January and prices range from £33 to £49 15s. Prices include control gear. *Merchant Adventurers (London) Ltd., Hampton Rd West, Feltham.*

"Gaiety" lamps

CROMPTON Parkinson's "Gaiety" lamps, illustrated in last week's issue of the ELECTRICAL TIMES, are designed for use with pendant mountings and not floor-standing units as shown in the photograph. They are diamond shaped and are intended to provide decorative lighting without shades in the home.

TRADE PUBLICATIONS

R. H. COLE.—Leaflet describing Siemens Halske type BY 242 silicon rectifier stocked by R. H. Cole (Overseas) Ltd., 2 Caxton St, S.W.1.

FLUIDRIVE.—Leaflet detailing the Vulcan-Sinclair Fluidrive. Fluidrive Engineering Co. Ltd., Fluidrive Wks, Worton Rd, Isleworth.

G.E.C.—Information leaflet on Witton-Kramer direct-current solenoids. G.E.C. Engineering Group, Erith, Kent.

GRIFFIN AND GEORGE.—20-page brochure describing new gas chromatograph, D.6. Printed in three languages it contains diagrams and photographs. Griffin and George Ltd., Ealing Rd, Alperton, Middx.

I.C.I.—Illustrated brochure describing titanium heating coils for the plating industry. I.C.I. Metals Division, P.O. Box 216, Birmingham 6.

KAY.—New catalogue for polythene fittings for tube installations. Kay and Co. Ltd., Bolton Brass Wks, Blackhorse St, Bolton.

L.P.A.—Illustrated price list of products by Light and Power Accessories Co. Ltd., Wellesley Rd, Wood Green, N.22.

MORPHY-RICHARDS. — New sales leaflet for electric underblankets. Morphy-Richards (Cray) Ltd., 50 Conduit St, W.1.

PHILIPS. — Leaflet describing microwave instruments and components for the 3 cm and 8 mm bands. Research and Control Instruments Ltd., 207 King's Cross Rd, W.C.1.

News of the Week

I.E.E. Announce New Learned Society Structure

Three divisions, 28 professional groups replace the four sections

DETAILS are reaching IEE members this week of the new "learned society" organisation of the Institution, under which its technical activities will be organised in three divisions and 28 "professional groups."

Members are being invited to register for the electronics division or the power division if they are engaged in a branch of the profession involved.

As already announced, the three divisions are concerned with electronics, power and "science and general." The professional groups organised within each division are noted below, and the official IEE statement notes that the range of a division's activities can be determined by aggregating the fields covered by its professional groups.

Unlike the power and electronics division, the science and general division will make membership available to all members of the Institution, whatever their professional activities.

The new arrangement will apply from 1 Oct., 1962, subject to confirmation by the Privy Council of the necessary changes in the IEE by-laws, voted last month. The modified arrangement will not affect student members.

The professional groups with which members can register are as follows (the list is intended to be flexible):

Electronic Division: Electronic measuring instruments and techniques; Computer design; Semiconductor devices; Components, including electronic valves and tubes; Medical electronics; Line and radio communication systems, including circuit theory and communication theory; Electromagnetic wave propagation; Microwave devices and techniques for communication; Sound broadcasting and television, including electroacoustics; Radio navigation and location.

Power Division: Rotating electrical machines and associated control gear; Railway traction, including signalling; Road, air and sea transportation; Industrial applications and processes; Non-industrial applications; Rectification and inversion equipment; Transmission and distribution plant; Cables and overhead lines; System planning control and operation; Generation—conventional and nuclear fuels.

Science and general division: Novel methods for the generation of electricity; Research on the properties and testing of materials and on related phenomena; Electrical and magnetic phenomena in ionised gases and in vacua; Generation of coherent radiation from electrical and nuclear energy-transitions; Basic electrical theory and advances in methods of measurement, units and standards; Process and position control servo-mechanisms and associated computers; General applications of computers, data and document handling, recognition systems, combinatorial devices, information theory; Education and training.

Wandleside in German Link

WANDLESIDE Cable Works Ltd. have formed their own link with the Common Market. They are to work in technical and commercial collaboration with Continental Electroindustrie Ag, who have cable factories at Wuppertal, Wipperfrüth and Bremen and are known as Kabelwerk Vohwinkel. The collaboration will also extend to Wandleside Warren Wire Co. Ltd. and Irish Cables Ltd.

* * *

Warren Wire Acquisition

At the weekend it was announced that Wandleside Warren Wire Co. Ltd., of Dunmurry, N.I., is now a wholly owned subsidiary of the Falks Group, of which Wandleside Cable is a member.

As a result, Mr and Mrs J. R. Cook are no longer members of the board of Wandleside Warren, which was previously 51% American, but Mr W. L. Wray remains managing director of the three cable companies, and the technical aid agreement with the American companies is widened and lengthened.

No Appliance Merger

A SMALL amount of fire seems to have given rise to the smoke in the City last week concerning a mooted link-up between major appliance makers, including Prestcold, AEI-Hotpoint and English Electric, but the word "merger" was definitely out of place.

Mr Alexander Abel Smith, chairman of Pressed Steel, is believed to have broached the idea of some kind of commercial link-up in conversations with Lord Chandos and EE executives, but EMI and GEC, mentioned in the rumours, had not come into the picture. There is a possibility that Mr Abel Smith will issue a statement soon to clear the air.

Engineers' Wage Claim Rejected

THE claims for increases in wages and shorter hours in the engineering industry were flatly rejected by the Engineering Employers' Federation last week. In their reply to the claim, the latter referred to the near possibility of entry into the Common Market, stressing that managements' first responsibility must be to cut costs where possible. Unless they could become more competitive, the present level of employment could not be maintained.

For the employees, a wage increase of at least £1 a week, with a reduction in hours from 42 to 40 a week, is being sought and the matter will next be considered by executives of the 39 unions in the Confederation of Shipbuilding and Engineering Unions when they meet on 11 Jan.

60% SELF-FINANCING FOR SUPPLY

SURPLUSES totalling £325 million are expected to be earned by the electricity boards in England and Wales during the five financial years 1962-63 to 1966-67. This was stated in the House of Commons last week, when the Minister of Power sought approval for an increase in the industry's borrowing powers.

The limit of borrowing for the Electricity Council and the English and Welsh boards was duly extended to £2,300 million; and that for the South of Scotland EB to £135 million.

About half the surplus in England and Wales is expected to come from the CEGB and about half from area boards. The industry should be financing 60% of its capital requirement by 1966. (It seems, however, that this 60% is calculated in a way different from that used by the Electricity Council in its annual report.)

New generating plant, so important an item in capital programmes, is continuing to fall in price. For conventional power stations, the Minister estimated £53/kW installed in 1958, £40/kW today, and £35/kW or less by the end of the 1960's.

Making the official reply to the discussion, the Secretary of State for Scotland announced that "a very large increase" in the scale of research and development by the supply industry is planned for 1962-63.

SOME MANUFACTURERS ANGERED BY TESCO PRICE CUTTING

Hoover's block supply and Belling investigate legal action

THE resale price maintenance war has flared again as a result of the opening of Tesco's first discount store in Leicester last week. There, on the ground floor of a new multi-storey car park near the main shopping centre, shoppers are circulating with supermarket-style baskets and buying electrical goods at cut prices, as well as other merchandise.

Virtually the complete range of vacuum cleaners made by Hoovers, one of the staunchest supporters of RPM, are being offered at up to £5 below the fixed price. This is the cut on the large upright model, while the Junior is reduced from £25 12s 1d to £22 12s, with a further 10s reduction on the accessories, and the Constellation is marked down £2 at £16 7s 6d. However, Hoover's have been quick to act. They have already traced the source of supply and stopped it.

Other goods on the Tesco shelves include Belling's Hotspur and Princess fires, marked down 7s and 10s, respectively, as well as Berry's and GEC fires, Remington and Philishave shavers and, in the front window, a Morphy-Richards toaster. The store is attracting considerable crowds, helped by its novelty; meanwhile Belling are considering legal action and, like other manufacturers, endeavouring to track down the source of supply.

Several firms, including McMichael, Berry's and Black and Decker Ltd., have warned Tesco against cutting prices on their goods, and others may follow suit.

Nor is this the only attack on RPM during the week. Frazeley Enterprises Ltd, at Birmingham, advertised an auction of unused washing machines, fires, 300 electric blankets, which were understood to be "Thermat" brand, and electric kettles. Bulpitt's, for their part, have brought up all stocks of their kettles and other products going at below the fixed price.

There is a feeling among appliance makers supporting RPM that things are coming to a head, that the Government must decide whether it will fully implement this side of the Restrictive Trade Practices Act, or allow the established distribution pattern to collapse. There are also allegations within the industry that some major appliance manufacturers are not sincere in their RPM policies, and are turning a blind eye to price-cutting on their goods.

E.C.A. aims on R.P.M.

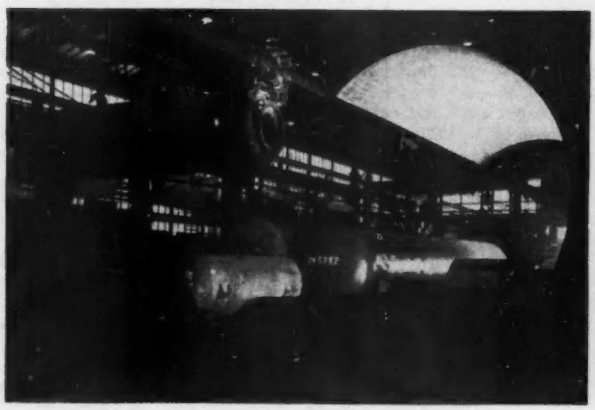
THE policy of the ECA and allied associations was to make every possible effort for the continuance of resale price maintenance and ensure that electrical equipment reached the public through genuine electrical retailers. This was stated by Mr G. N. Walker, ECA National president, at the jubilee dinner of the Birmingham branch recently.

The retail side of the industry had had all kinds of difficulties in the past year, including the credit squeeze and the "Little Budget," and there seemed little likelihood of a relaxation in the next 12 months, he added.

Earlier, the Birmingham city architect, Mr A. G. Sheppard Fidler, in proposing the toast of "The Association," said that he thought there were three things absolutely necessary to the industry, a regular programme of work, intelligent organisation, and a constant intake of well-trained men.

What about the workers?

THE *Financial Times* reports that New York electricians may strike on 1 Jan. if they do not get a 20-hr working week, adding that the 6,000 local members of the International Brotherhood of Electrical Workers now have a 30-hr week.



10,000 BOILERS

A view one of the fabrication shops at the Ettingshall works of John Thompson Ltd., where the 10,000th shell boiler produced there has just been handed over. The boiler drum seen being handled by the crane weighs 65 tons. In the foreground a boiler plate is being fabricated on a roll-forming machine

M.E.B. to count rooms in 1·3m homes

MIDLANDS EB will have a big job commencing early in the new year visiting each of the 1,300,000 homes in the area to re-assess the number of rooms, upon which domestic tariff charges are based. To supplement the present staff, it will be necessary to recruit temporary staff in most districts, and suitable recruits will be sought shortly.

The Board's chief commercial officer, Mr J. J. Gibson, said: "The assessment of rooms upon which accounts are at present based was made in 1951, when tariffs throughout the MEB area were standardised. After ten years it is time a new assessment was made. Details of our proposals have been given to the Consultative Council, and we are confident of their report." The survey is expected to take at least 12 months to complete.

Floor-warming for 168 flats at Liverpool

A £500,000 tender for the construction of a 22-storey block of flats, the first part of the redevelopment scheme for Harding St, has been accepted by Liverpool City Housing Committee.

Containing 126 two-bedroomed flats and 42 one-bedroomed flats, the block will incorporate electric floor-warming in the living room and kitchen of each flat, and the living room will also have an electric fire. Each flat is to have its independent immersion water-heating system, and supply points will be provided in every room.

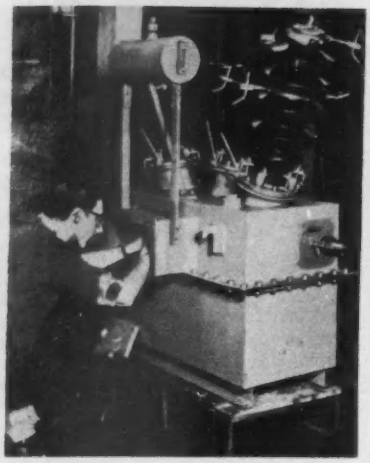
What is a "Negistor"

THE electronics industry is constantly inventing new technical terms which can be puzzling to those outside their own circle when heard for the first time. A recent term is a "negistor" which, according to *Philips' Telecommunications Review* and for the benefit of the uninitiated, is "a transistorised negative impedance repeater."

It is, in effect, a transistorised version of the conventional voice-frequency two-wire hybrid repeater used in telecommunications and is simpler and smaller; therefore more economical. Characteristics and operation of the "negistor" are outlined in an article in the October issue of the *Telecommunications Review*.

Wholesaler Acquired

KERRY'S (GB) LTD. have acquired J. Beaumont & Son Ltd., wholesalers of radio, electrical, cycle, motor and industrial supplies at Newcastle, Carlisle and Darlington. Kerry's, who are mainly motor car accessory distributors, have not previously covered that area to any extent.



Final assembly work on one of 18 33 kV outdoor type voltage transformers ordered from Foster Transformers for export to Tanganyika

ELECTRICAL ENGINEERING EMPLOYS MOST RESEARCH ENGINEERS

But 12% more are needed

THERE is an acute shortage of engineers in the field of research and development in engineering. This is borne out in the report of a survey into "Industrial Research in Manufacturing Industry," carried out by the FBI in conjunction with the National Institute of Economic and Social Research during 1959-60.

It is the first investigation to attempt a qualitative, as well as quantitative, analysis of research and development in British manufacturing industry. The survey was conducted by means of a questionnaire sent out in 1960 and the results have now been evaluated and set out.

Only a small proportion of the research and development expenditure in industry as a whole is devoted to work other than that carried out within the firm. Excluding the aircraft industry it amounts to only 4%, although the proportion in some industries is very much higher. Of this expenditure, about two-thirds goes to research associations and the remainder is direct payments for work done by universities, DSIR laboratories, sponsored research institutes and similar bodies.

The survey showed that firms which were conspicuous for their growth during the last few years in the industries examined were those with a considerable research expenditure. On the other hand, the questionnaire shows that private manufacturing industry spends just over half as much on basic research as do the universities.

High Vacancy Rate

Two-thirds of the total qualified scientists and engineers employed in research and development work are to be found in three main industries, electrical engineering, chemicals and aircraft. Of this figure, the largest number of scientists and engineers in research and development are in the electrical engineering industry.

Notable, however, is the fact that the number of holders of Higher National Certificates and Diplomas employed in research and development is 54% expressed as a percentage of scientists and engineers. In the electrical industry there are, at present, vacancies for engineers and scientists totalling 11·9% of those already employed in research and development. In 13 companies in this industry, a total of more than £34 million is currently being spent on research and development.

More Money For British Inventions

ACCORDING to the twelfth annual report, out last Thursday, of the Government-sponsored National Research Development Corporation, a record sum of £812,000 was spent last year on developing British inventions. This compared with the previous highest figure of £592,000 spent in 1959.

During the year under review, the Corporation provided financial and other assistance for nearly 40 development projects. Although this included seven new ventures, a major part of the work had been concentrated on the advancement of established projects. Recurring royalty payments, which formed a major part of the Corporation's exploitation income, increased last year, but the Corporation again pointed out that it was extremely difficult to predict whether it would be possible to recover enough profit from successful ventures to cover accumulated interest on its Board of Trade loans and losses on unsuccessful projects.

Amongst individual projects on which development work had been in progress during the year under review, work on automatic process plant control was now well advanced and consideration was being given to experimental practical applications. The project contemplated development of a range of standard equipments which would permit electronic analogue and digital computing techniques to be used for control of power stations and chemical plants. Support by the Corporation for work on the Sondes Place type fuel cell had continued, whilst further research on the Bacon type hydrogen/oxygen cell was now in the hands of three major companies who had agreed to co-operate in development work. In the field of thermionic generation, Professor Gabor and his team had met with encouraging results and, at the present time, the possibility of setting up a collaborative programme with the UKAEA was under discussion.

OFFICIAL PUBLICATIONS

Industrial Research in Manufacturing Industry, 1959-60. FBI. £2 (see this page).

National Research Development Corporation. 1960-61 Report. HMSO. 2s 3d (see this page).

BS amendment slips:

162, Electric Power Switchgear and Associated Apparatus, PD 4359; 862, Air-break Circuit-breakers, including Totally Enclosed and Flameproof Types, PD 4365; 903, Methods of Testing Vulcanised Rubber. Part A2, Determination of Tensile Stress Strain Properties, PD 4351; 1441, Galvanised Steel Wire for Armouring Submarine Cables, PD 4323; 1990, Wood Poles for Overhead Lines (Power and Telecommunication Lines), PD 4327; 3456, The Testing and Approval of Domestic Electrical Appliances. Section A2, Electric Fires, PD 4376; Section A3, Electric Kettles, PD 4377; Section A5, Electric Toasters, PD 4378; Section A6, Electric Coffee Percolators, PD 4379; Section A7, Electric Washboilers, PD 4360; Section A8, Electric Immersion Heaters, PD 4380; Section A9, Electric Irons, PD 4361; Section A10, Electric Steam Irons, PD 4381.

£337,000 N. Ireland Scheme Approved

THE £337,532 distribution reinforcement scheme for the Carnmoney area, to which we referred on 2 Nov., has now been approved by Belfast Corporation Finance Committee. The Carnmoney scheme is regarded as urgent, as substantial power supplies will be required at the new factory estate of the Ministry of Commerce at Monkstown in 1963.

It is proposed to establish a new substation taking supplies from the existing main duplicate circuit transmission line between Ballylumford power station and Finaghy switching station. In addition, duplicate feeders will be extended from the new substation to the area of the factory estate south of Monkstown. Eventually, these lines will supply a future substation near Whiteabbey.

STEAM PIPES NOT RATEABLE

—but supports are

A DECISION on whether certain steam pipes and their metal supports and concrete foundations in a factory were rateable was given by Mr E. Simes, Q.C., a member of the Lands Tribunal, in London last week. He was giving a reserved decision on a point of law as to whether the installation at the Bromborough Port works of Lever Brothers, Port Sunlight, which carried h.p. and l.p. steam from two electricity generating stations to nearby factories, was plant and machinery, or was liable to rating as part of the hereditament.

Mr Simes held that the steam pipes were not "buildings or structures or in the nature of buildings or structures," and were therefore not subject to rates.

Concerning the supports themselves he did not regard them as "buildings or structures," but as they were integrated in the concrete blocks he believed they must partake of the nature of the blocks which were constructed on the site, and were intended to remain there. In Mr Simes' opinion the blocks and supports should be regarded as part of the hereditament, which meant they were rateable.

Mr Simes ordered the valuation officer to pay costs to Lever Brothers.

Copper Giants May Merge

BRITAIN'S largest copper suppliers, Rhodesian Selection Trust and Roan Antelope, neighbours in the North Rhodesian copperbelt, are planning a £94 million merger. Both companies share Sir Ronald Prain as chairman, but each holds no shares in the other at the moment. The only link comes through American Metal Climax, which owns a controlling 50·6% of RST and 32·65% of Roan. If the merger succeeds, Roan will be liquidated and the US firm's interest in the enlarged RST will be only 43·5%.

Radiation Consolidate Australian Interests

ARRANGEMENTS have reached an advanced stage for Radiation to bring the manufacture and distribution of their New World range in Australia under the wing of their Parnall (Australia) Pty. Ltd. subsidiary, which already handles their other products in that country.

To do this, Radiation have agreed to acquire the domestic appliance interests in Australia of Coates and Co. Ltd. and its subsidiary, Radcoates (Pty.) Ltd. Terms are payment in cash for the book value of the net assets as at 30 June, 1962, of the Appliance Division of Coates and Co., who have hitherto operated a manufacturing and agency agreement for the New World products. The arrangement is now subject only to the approval of Coates' shareholders.

COOLING TOWER DESIGN AWARD

THE Institution of Civil Engineers' Charles Hawksley prize for 1961, of £150, has been awarded to Mr A. R. Burton, of Margate. Both he and the third-prize winner, Mr I. G. Heggie, of London, submitted designs for a cooling tower in reinforced concrete. The second prize, of £100, went to Mr B. T. Keay, of High Wycombe, whose design was for thin shell roofs for a community centre.

PLESSEY MAKE U.S. SWITCHES

AN American range of precision snap-action switches, suitable for domestic appliances and many other applications, is to be made by Plessey's Havant factory under a licence agreement just announced. Name of the range is Licon R, and the licence from Illinois Tool Works Inc. includes marketing in the UK.

Illinois Tool have a subsidiary at Slough, ITW Ltd., but it is understood that the switches have not hitherto been on the UK market.

Semi-Conductor Newcomers

MARKETING in the UK of semiconductors to the design of Fairchild and Camera and Instrument Corp., New York, is planned by Fairchild's Italian associate, Societa Generale Semiconduttori, of Milan. Application has been made to register SGS-Fairchild Ltd. in Britain.

A.E.I. Makes Plant for Corby Steel Mill

AEI's Heavy Plant Division are to supply and erect electrical plant for No. 1 Strip Mill, at Stewarts and Lloyds' Corby rolling mills, and also for a new 20 in. bar mill. Value of the contracts is £440,000.

No. 1 continuous hot-strip mill is being modified and this involves the replacement of the five existing finishing-train stands and motors. AEI are supplying the five motors, all 2,000 h.p., 350 r.p.m., 650 V d.c., as well as two 3,750 kW mercury-arc converter equipments and complete new control equipment. All motors have closed-loop speed control, and provision will be made for varying the voltage output of the converters by static grid-control circuits, the input signal being derived from the reference circuits through a transistor amplifier.

The 20 in. bar mill will be fitted with 3,750 kW mercury-arc converter equipment, a 40 kW germanium rectifier unit and control gear. Delivery is programmed for June, 1962.

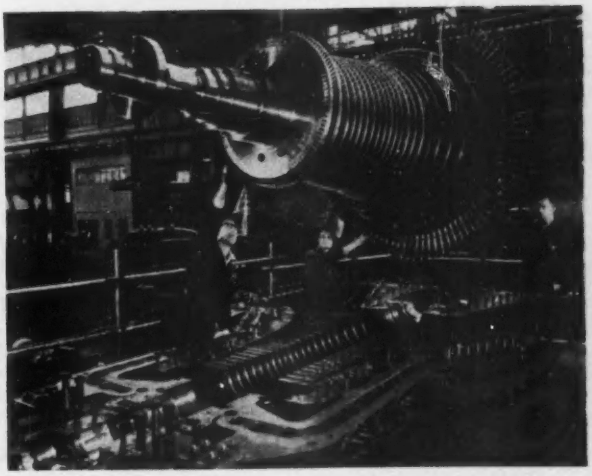
* * *

Another AEI contract is for Construction (Cables and Lines) Division to reinforce Wimbledon's power network. The order, worth £118,000, will involve installing four runs of 33 kV three-core oil-filled cable and two runs of auxiliary cable over a two-mile route. The cable will be made at Gravesend and Woolwich.

* * *

In addition, AEI have won a £250,000 order to supply switchgear for a new CEGB 275/33 kV substation at Aldwarke, which will augment supply to Park Gate Iron and Steelworks.

GOING TO MEXICO



One of three 33 MW steam turbines for Ciudad Delicias Mexico being supplied by AEI Ltd, during assembly at the Trafford Park Works. AEI are supplying the complete power station, with Babcock and Wilcox providing the oil-fired boilers

Line Diverted for Housing Estate

FIFE Housing Committee have approved the payment of £11,365 to the South of Scotland Electricity Board for the work of diverting overhead power cables at the Lochore housing site. The site would accommodate the 200 houses planned, and the diversion would make available to the County Council very much more land. Mr A. Eadie, chairman of the Committee, explained. Earlier, the estimated sum which the County Council were being asked to pay was £30,000.

No Aluminium Posts for Middlesbrough

MIDDLESBROUGH propose to use steel street lamp columns after all. The Corporation Watch Committee have now reversed their earlier decision to buy 700 aluminium columns after the matter was referred back by the Town Council. As Middlesbrough draws a large part of its livelihood from steel making, several members thought they should support home industries and have steel columns, particularly as trade is slack. The 700 aluminium columns were intended for the first stage of a five-year plan for the conversion of gas-lit streets to electricity.

E.T.U. defendants drop appeal

OF the five defendants in the ETU ballot-rigging action in the High Court last summer, only one now intends to appeal—Mr Frank Foulkes, the president, who has been refused legal aid. The other four, Mr F. Haxell, former general secretary, Mr R. G. McLennan, acting assistant general secretary, Mr J. N. Frazer, one of the defeated members of the ETU executive committee, and Mr J. Humphrey, office manager, have decided not to appeal. The latter was suspended from his position by Mr J. Byrne, the new general secretary, but was not dismissed pending the appeal. The union's own appeal is also dropped.

Sayings OF THE WEEK

"If we are to make the most of science in industry we need . . . (iv) prompt management decisions to provide the finance for promising innovations and, where necessary, to adapt management arrangements." . . . PROF BRUCE WILLIAMS, in FBI report on Industrial Research in manufacturing industry.

"We regret that you should have thought fit to indicate that our relations are bedevilled in any way, and we therefore feel entitled to suggest that if they are, the continuous pattern of claims by unions who appear to be quite insatiable is perhaps the primary cause." . . . MR B. MACARTY, director, Engineering Employers' Federation, in rejection of pay claim.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Monday, December 18

	£ per ton	Weekly change £
COPPER, standard class A (settlement) ...	230½	−2½
" (3 months)	231½	−2
LEAD, refined pig, 99·97% purity (cash)	60½	−½
" (3 months)	62	—
TIN, refined, min. 99·75% purity (settlement)	952½	−1½
" (3 months)	963	−2
ALUMINIUM, ingots 99·99·5% ...	186	—
" wire bars (4×4×54")	193½	—
BRASS Strip 63/37	198½	+3
SILVER (Troy oz)	87½d	+½d
ZINC, virgin, min. 98% purity (cash)	72½	+½
" (3 months)	73½	+½
RUBBER, per lb No. 1, RSS, spot	23½d	+½d
c.i.f. basis, ports, Feb. ...	23½d	+½d
ARMOURING: Galv. Steel Wire (0·104 in.) ...	68†	−½
Mild Steel Tape (0·04 in.) ...	54*†	+½
NICKEL (home)	660	—
MERCURY (76 lb flask)	59	—
AMERICAN PRICES: Copper, electrolytic (per lb) ...	31c	—
Lead (New York)	10½c	—

* Tape Price, now an average, includes varnishing † As from 19 December

Record £160 collected by E.I. Club

"THE Kinetic Relationship Between the Actor and the Electrical Laity with Some Observations on Megohms, Milliamps and Other Malfeasances" was the title of Mr Bernard Miles's light-hearted talk at the Electrical Industries' Club Christmas luncheon last week.

Mr Miles was warmly applauded and, following the president's vote of thanks, Mr E. G. Batt, vice-president, made his Christmas appeal on behalf of the older beneficiaries of the EIBA. This resulted in the collection of a record £160.

As on previous occasions, several retired members of the Club were among the specially invited guests and Mr Victor Dale proposed a vote of thanks on their behalf.

The next meeting will be held on 9 Jan.

HOOVER EXPAND AT HIGH WYCOMBE

ADDITIONAL premises adjoining their High Wycombe factory have been acquired by Hoover Ltd. The new premises, on a site of nearly 2 acres, provide the company with an extra 8,500 sq ft of space for the manufacture of vacuum cleaner and polisher spare parts. Total area of the High Wycombe factory, where the steam-or-dry iron and spare parts for many of the company's products are made, is now over 86,250 sq ft.

"Hoover Housewife"

MRS CAROL HICKS, 35-year-old mother of three, has won the £4,000 prize as "Hoover Housewife of the Year" plus an additional £100 from her local dealer, H. Wigfall and Son, of Dewsbury, Yorks. Married to an assistant lecturer, Mrs Hicks's keen interest in dressmaking and arts and crafts helped her to win in the final series of tests before the judges this month.

Her prize from Hoover is a three-bedroomed Norwegian-style bungalow, fully furnished and equipped, a Hillman Minx convertible and £1,000 towards the cost of the land. The wife of the dealer receives a Hillman Minx saloon.

Power Plant Conference at Liege next June

A FIVE-DAY international study conference on "Modern Thermal and Hydraulic Power Plants" is to be held at Liège from 4 June to 8 June, 1962. Organised by the Association des Ingénieurs Electriciens sortis de l'Institut Electrotechnique Montefiore, there is to be discussion of reports submitted by foreign and Belgian specialists on boilers; steam and hydraulic turbines; and alternators. Technical visits are also planned, and other details may be obtained from the secretary of AIM, rue Saint-Gilles, 31, Liège, Belgium.

News in Brief

The Minister of Aviation, Rt Hon Peter Thorneycroft, will open the Electrical Engineers (ASEE) Exhibition at Earls Court on 20 March, 1962.

The new Canadian trans-Atlantic telephone cable was inaugurated by HM the Queen on 19 Dec.

The London Division Charge Engineer Society has changed it name to Charge Engineers' Society, South Eastern Region. Formed in 1954 to promote educational and social activities among CEGB generating staff, its president is Mr H. J. Bennett, Regional director, and hon secretary, H. K. Hewett, at Acton Lane Station.

The new Hainsworth Research Centre of J. H. Fenner and Co. Ltd., opposite their Hull factory, was opened by Lord Robens on 15 Dec.

Refugees from Tristan da Cunha, housed at Pendell Camp, Merstham, are being taught to use electric cookers by members of Seeboard staff.

Rheostatic Ltd. announce that a start will be made next year on a £500,000 factory at East Kilbride with an area of 200,000 sq ft.

OVERSEAS NEWS

from our correspondents abroad

CANADA

360 kV Line

A new 85-mile long 360 kV transmission line linking Bridge River to the Lower Mainland was put into service recently by the British Columbia Electric Co. The new line links Bridge River to the Cheekye substation, near Squamish. Erected over some of the touhgest terrain in North America, the line took four years to complete. Initially, it is operating at 230 kV, but has been built for 360 kV service.

Smoke Clouds?

Has Premier Bennett, of British Columbia, won his point on permitting the sale of BC's share of downstream benefits from the Columbia power project to America? Many officials in that Province now believe he has, basing their assumption on the wording of a new statement by the US Secretary of the Interior, Mr Udall. In this he stated that the Bonneville Power Administration would soon have authority to buy Columbia power and the US Government looked forward to early ratification of the treaty by Ottawa. But in that capital the Ministers seem to be unmoved.

NB Plans

The feasibility of a submarine power cable between New Brunswick and Prince Edward Island has been studied, but the New Brunswick Electric Power Commission reported that the project was not justified at the moment because of the high capital cost. This information was given to the Legislature recently by the chairman, the Hon D Harper, in the throne speech debate when he referred to the new thermal power plant to be built in the Grand Lake region. With a capacity of 60 MW, estimated cost of this plant was $10 million, with construction expected to be completed early in 1964. The Grand Lake region had been chosen, he said, because it was strategically located in the grid transmission system and near to coal supplies. He estimated electrical energy requirements for New Brunswick and Nova Scotia by 1980 to exceed 11 billion kWh, with 3 billion kWh available from a complete development of the St. John River potential, and the remaining kWh from thermal stations and other sources. The Commission's long-range plans provide for systematic and economic development of the province's hydro potential—with the St. John River providing the greatest source. In addition to Beechwood, there remained the MacNaquac site where over 4,000 MW could be generated, the Morrell site in Victoria County and a redevelopment of Grand Falls. Discussions had been held with US officials on joint development of the St. John River.

RHODESIA

Kariba Decision Deferred

The decision to shelve the construction of the north bank power station at Kariba for at least a year will defer capital expenditure of about £30.000.000, the Federal Ministry of Power has stated. A major factor that has made this possible is an increase in the power obtainable from the turbines in the south bank station. The increased output is estimated at between 10% and 15%. The Ministry of Power has emphasised the deferment is not due to a slackening in the rate of economic development and, therefore, in electricity consumption in the Rhodesias. "Consumption of electricity is running at a rate only a few per cent below that estimated six years ago," he added. Consideration is now being given to improving the transmission lines and ancillary equipment which form part of stage two of the Kariba scheme in anticipation of the date when the full scheme comes into operation.

GHANA

Volta Financing

It was officially announced last weekend that the US Government had agreed to grant loans for financing construction of the dam and the generating station for Ghana's Volta River project. The US will provide about £12 million, Britain £5 million, and the International Bank for Reconstruction and Development £10 million, with Ghana providing £30 million. An early announcement is expected of the award of contracts for the supply of generators and erection of transmission lines for the power project. Several British firms are involved.

Fuel and Power Control

President Nkrumah announced in Accra last week that he is taking control of Ghana's fuel and power sources with a new Fuel and Power Secretariat under the President's office. According to the official statement, this step has been taken "in view of the importance of developing all available fuel and power resources other than the major project at Akosombo, on the Volta River." At present, the principal towns in Ghana get their electricity supplies from undertakings operated by the Government Electricity Department, the chief engineer of which is Mr E. A. Sackey, O.B.E., M.I.E.E.

Membership of the Volta River Authority has also been announced. Under the chairmanship of the president are Mr F. Dobson (formerly with the Hydro-Electric Power Commission of Ontario) as chief executive, and Mr A. K. Rormer, the Development Commissioner.

PAKISTAN

Departmental Organisation

The West Pakistan Water and Power Development Authority is to reorganise its Electricity Department. Control of the department will now be under a general manager (who will also be the senior chief engineer). He will be assisted by two chief engineers in charge of operations and construction. All the present directorates connected with operations, such as power control, stores, operations and administration, will be under the charge of the chief engineer, operations. The latter will also control zonal offices, which are being increased from three to four by splitting the large Lahore zone. Each of these four zones will be headed by a deputy chief engineer at Peshawar, Lahore, Lyallpur and Hyderabad. The chief engineer (construction) will have under him two deputy chief engineers for powerhouses and transmission lines, respectively. A new feature is the establishment of a departmental inquiry agency, in the charge of a field officer not below the rank of a superintendent of police, whose purpose will be to prevent corruption in the Electricity Department.

Mangla Tenders

Evaluation of the tenders for construction of the Mangla Dam hydro-electric project, has been the subject of discussions in London this week by senior officers of the West Pakistan Water and Power Development Authority, and of the consulting engineers, Binnie, Deacon and Gourley.

AUSTRALIA

Steady Rise

A 10% increase in unit sales in the year ended 30 June last is reported by the Electricity Commission of New South Wales. Generating plant totalling 326 MW in capacity was added to the system during the year, bringing the Commission's total generating capacity to 2,170·37 MW. Among the plant commissioned were two 100 MW sets at Tallawarra, a 60 MW machine at Wangi and a similar set at Wallerawang. Maximum demand rose 5·6% to a record of 1,866 MW. Work continued on the design and construction of the 330 MW transmission system that will eventually extend from Armidale in the north to Snowy Mountains in the south. The Dapto-Sydney line was completed and this, together with the new 330 kV line now under construction from Yass to Dapto will bring power at 330 kV into Sydney for the first time early next year.

Company Activities

ALMOST, one could say, it was a Father Christmas week where good news far outweighed for once the depressing items. It is clear from the most recent pronouncements of Mr George Ball, US Under-Secretary of State, that the Kennedy Administration intends to carry through a policy of tariff-cutting so that for Britain (and for Europe) the opportunities for trade may be the best since the war.

"Over there," Wall St also last week went on to a new all-time "high," while over here there was the news that the TUC may join the Government's National Economic Development Council despite the pay pause and the announced improvement in the UK's November trade gap (£41 million against £56 million in October). All served last week to lift the *Financial Times* index 6·4 points to 299·8.

The US scramble, too, for the Unilever twins also played a full part in the pre-Christmas strength of equities. Now quoted on the "Big Board" in New York alongside its Dutch sister, Unilever NV, the British "end"—i.e., Unilever Ltd.—rose only 1s 10½d over the week to 48s 9d, but this was after changing hands at 55s. It is, moreover, estimated that US buying in London of "Ltd" last week totted up to around £8 million, some amount of which will already have been used in alternative equity investments to provide Throgmorton St with a degree of windfall leavening.

Talk that Elliott-Automation may be amongst the next crop to apply for a Big Board listing in New York then served to push the company's 5s Ordinary shares on to a new peak of 43s 1½d after a 39s 3d start. On balance, in fact, the electrical market last week took a turn for the better. Ever Ready lit up from 42s 9d to 45s, Berry's were a shilling dearer at 65s and Thorn improved from 63s to 65s 6d. Brisk demand for Joseph Lucas boosted the shares from 56s 3d to 61s 3d and Reyrolle, among the "heavies," gained 2s a share at 44s 3d.

But the "Big Three" were still very much under the weather. AEI dropped back 1s to 28s 6d, English Electric 6d to 23s 6d and GEC 1s to 23s 3d.

The sun, however, was shining once again for the Decca two, and no doubt helped by the estimate that consumer spending on "discs" this year will amount to £31·5 million against £29 million last year and £25·7 million in 1959, Decca's Ordinary shares spun up from 73s to 75s 6d, and the "A" from 67s 6d to 69s.

But brightest in the whole market last week was the 8s 3d a share rise to 106s 3d in International Computers and Tabulators, Britain's and Europe's largest in this particular field. Behind this lightning addition to the company's stock market value was the £1·6 million jump in before tax trading profits, from £7,925,000 to £9,506,000 for the year ended 27 Sept. New chairman Sir Edward Playfair also pointed out that ICT's rapid growth is involving heavy expenditure on training, systems study, and so on, which, as in the case of research expenditure, is written off at once although the corresponding financial benefit lies entirely in the future. And but for this factor the year's growth in profit would have been materially greater. So although the total dividend was no more than forecast (maintained at 2s 3d a share on the capital increased by a 1 for 4 rights issue), the happy thought of "materially greater" rewards that will in the not too remote future come the way of ICT shareholders was enough to take the £1 Ordinary shares to within only 1s 3d of their 1961 "high." And a long, long way from their 56s 3d "low."

Scarcely could Santa Claus himself have bestowed so happy a tax-free gain!

—*From our City Correspondent.*

Amalgamated Industrials

Acquisition towards the end of 1960-61 of the whole of the capital of Electro Dynamic Construction Co. is serving to offset lower profits recently from the group's other interests, which include Knitmaster as well as steel stockist, engineering and woodturning firms. The group chairman, Mr A. E. Somers, told the annual general meeting last week that Electro Dynamic's results are exceeding expectations.

Consolidated Electrodynamics Corp. (UK)

Although operations began only two months ago, orders "beyond our most optimistic hopes" had been received, Mr E. F. Wagner, president of the international division of Bell and Howell, the Chicago parent, said when he visited the Woking headquarters last week. The factory rented at Farnborough, Hants, will begin production in the near future.

Elliott-Automation

Construction of a £A1 million manufacturing plant at Bankstown, Sydney, has begun. It is hoped to start production about April, and the entire project should be completed by June.

International Computers and Tabulators

Although rapid growth is involving heavy expenditure on training, systems study and research, which is written off immediately, trading profit jumped from £7,925,000 to a record £9,506,000 in the year to 27 Sept. As forecast, dividend is maintained at 2s 3d, or 11¼%, on capital increased by a one-for-four rights issue. The payment absorbs £861,000 of the £1,584,000 net profit, giving a cover of 1·8 times. Net profit in the previous year was £1,435,000. Exchange of information with Radio Corp., of America, has already begun under recent agreements.

Oldham and Son

In the happy position, as far as the recent past is concerned, of supplying batteries for passenger cars on a replacement basis only, but as original equipment, too, in the case of commercial vehicles, Oldham have not been prevented by the troubles of the car industry from declaring a steady 7½% interim dividend. Full distribution last year was 17½%, the same percentage as was paid in 1960 before a one-for-two bonus issue.

Radio Rentals

Following a further sharp rise in earnings during the year to 31 Aug., dividend is raised from 20% to 22½%. Trading profit is just over £¾ million higher at £6,497,337, but this increase is offset by a similar rise in depreciation, so that net profit attributable to the parent company is virtually steady at £1,564,718, against £1,573,987 previously.

Skefko Ball Bearing Co.

£1·6 million is to be raised by a rights issue early in the New Year, subject to exchange control consent, for participation by the Swedish owned company. The issue also depends on market conditions at the time being "not markedly different." The intended issue is of £500,000 £1 shares at 65s each, on a 1-for-12 basis. Simultaneously directors say the current year's profit should not be less than that for 1960.

Tube Investments

Sir Ivan Stedeford, chairman, does not expect the current year's result to be as good as last year's, but he gives a strong hint that dividend will be maintained at 14%. Results should not be significantly different from 1959-60, when the equivalent of that rate was paid, he states.

Waite and Son

Shareholders will vote on 29 Dec. on a proposal for the company to acquire three lampshade companies from Mr G. R. Jarvis, who is also the Waite chairman. Price would be 300,000 Ordinary 2s shares, based on an independent valuation of £135,000, of which £125,924 is goodwill. Therefore the criterion is earnings, and Mr Jarvis states that Waite's profit of £70,926 before tax in 1961, contrasting with 1960's £13,777 loss, was due in great measure to these three companies, Apex Mfg., Auro Lampshade, and Adalight, operating virtually as part of Waite throughout the year. He estimates that profit before tax this year will be similar to that of 1961, and directors intend to declare an interim dividend of 10%, matching the past year's full 20% rate.

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

21 Dec.—Bristol C.C. (a) Electrical installation, on fixed-price basis, in Bristol Technical College. Applications to City Architect, Council Hse, by above date. N.I.C. firms only.

23 Dec.—Perth and Kinross J.C.C. Electrical work in erection of School for Mentally Handicapped Children at Scone. Applications to County Architect, New Schools Section, Old Academy Bldgs, Rose Terr, Perth, by above date. N.I.C. firms only.

27 Dec.—Cumberland C.C. Ambulance radio communication system. Applications to Clerk: G. N. C. Swift, The Courts, Carlisle, by above date.

27 Dec.—Ealing B.C. Electrical installation renewal in Selborne Primary and Secondary School, Conway Cres, Greenford.—Advertised 30 Nov. issue.

27 Dec.—Haltemprice U.D.C. Supply of one street lighting vehicle fitted with a Simon L.25 hydraulic platform. Engineer and Surveyor.

27 Dec.—Kidsgrove U.D.C. Supply, erection and wiring of 27 Class "B" lighting units. Engineer and Surveyor, Town Hall. Deposit £1 1s.

28 Dec.—Belfast C.C. (b) Electrical installation in proposed extensions to Graymount Open Air School.—See 7 Dec. issue.

28 Dec.—Dunbarton C.C. Cabling, erection and wiring of 71 fluorescent lighting units on 25 ft columns along Ring Rd, Cumbernauld New Town. Applications to County Lighting Superintendent, W. Arthur, 24 George Sq, Glasgow C.2, by above date.

29 Dec.—Braintree and Bocking U.D.C. Group "B" lighting: (1) erection of 81 Group "B" concrete columns; (2) supply/erection/wiring of 78 sodium lanterns; (3) supply/erection wiring of four fluorescent lanterns; (4) cable laying; (5) removal of existing installations.—See 7 Dec. issue.

29 Dec.—West Lothian C.C. (8) Electrical work in erection of an old people's home at Blackburn. Applications to County Architect, County Bldgs, Linlithgow, by above date.

30 Dec.—West Lothian C.C. Supply and erection of 93 200 W long type sodium lanterns on 35 ft steel columns along A8.—See 14 Dec. issue.

1 Jan.—Buntingford P.C. Supply and erection of 18 columns with 140 W sodium lighting on A10.—See 7 Dec. issue.

1 Jan.—Co. Down. Installation in new school at Lurganville.—See 7 Dec. issue.

1 Jan.—Newport C.B.C. Erection/painting of steel lighting columns and provision/putting into operation of sodium lighting along Caerleon Rd and Mendalgief Rd. Details from Borough Engineer, Civic Centre, on production of £2 2s deposit receipt from Borough Treasurer.

1 Jan.—Richmond (Surrey) B.C. Supply and erection of externally illuminated traffic signs. Borough Engineer and Surveyor, King's Rd.

2 Jan.—Cannock U.D.C. Supply and erection, on fixed-price basis, of (a) five 140 W sodium lighting units on 25 ft concrete columns and (b) 12 240 W fluorescent units on 25 ft steel columns. Engineer and Surveyor: E. Lomax, Council Hse, The Green. Deposit £2 2s.

2 Jan.—N.I. Hospitals. (3) Electrical services in the provision of annexes at Whiteabbey Hospital.—See 7 Dec. issue.

3 Jan.—Nuneaton B.C. Erection of 276 steel columns and wiring of 33 60 W and 211 45 W sodium lighting and 32 100 W tungsten lighting.—See 14 Dec. issue.

5 Jan.—Bournemouth C.B.C. Contracts 5 and 5A—Holdenhurst sewage disposal works: electrical installation; oil-filled tubular heaters; underfloor heating. Details from Farmer and Dark, 14 High St, Poole.

5 Jan.—Downpatrick R.D.C. Supply and erection of 951 intermediate and Group "B" fluorescent street lighting units. Clerk, Quoile Rd, Downpatrick, Co. Down.

5 Jan.—Wanstead and Woodford B.C. Supply: lamps.—See 7 Dec. issue.

5 Jan.—Wood Green B.C. Supply: lamps.—See 14 Dec. issue.

6 Jan.—Dagenham B.C. Supply of (List 31) lamps for year. Borough Engineer and Surveyor, Civic Centre.

8 Jan.—Blackpool C.B.C. Supply of street lighting equipment.—Advertised in 7 Dec. issue.

8 Jan.—Blackpool C.B.C. Supply: lamps.—See 14 Dec. issue.

8 Jan.—Manchester C.C. Electrical installation in workshop at St. Joseph's Police Bldgs, Longsight.—See 14 Dec. issue.

8 Jan.—Nottingham C.C. Two centrifugal pumps complete with motors, switchgear, etc.—See 7 Dec. issue.

8 Jan.—Skipton U.D.C. Rewiring of 149 pre-war council houses, Burnside estate.—Advertised 14 Dec. issue.

8 Jan.—West Lancs R.D.C. Supply, erection and commissioning of 55 Class "A" units comprising 140 W sodium lighting on concrete columns. Divided: (a) supply of columns/brackets; (b) supply of lanterns, lamps, gear and time-switches; (c) erection/wiring and removal of redundant equipment along A565.—Advertised 14 Dec. issue.

10 Jan.—Bath C.C. Supply of street lighting equipment: (List 29) illuminated bollards; (42) cables; (43) discharge lamps; (44) tungsten lamps and fittings; (45) steel and concrete columns; (46) lanterns; (47) control gear and capacitors; (48) time switches.—See 14 Dec. issue.

10 Jan.—Blyth B.C. Supply of (list 14) cables and fittings for year. Borough Engineer, Municipal Bldgs.

10 Jan.—Worthing B.C. Supply of (List 13) lamps for year to 31 March, 1963. Borough Engineer, Town Hall.

12 Jan.—Easington R.D.C. Supply of (list F) electrical goods for year. Engineer and Surveyor, Council Offices.

12 Jan.—Grimsby C.B.C. Contract C. Electrical installation, on fixed-price basis, in Grange Primary Junior School, Cambridge Rd.—See 14 Dec. issue.

12 Jan.—N.I. Hospitals Authority. Supply of: (a) heated food conveyors for new Ulster Hospital, Dundonald. Secretary, Ulster Hospital Management Committee, Whitehall Parade, Belfast 7.

12 Jan.—Worcestershire C.C. Supply/erection/wiring/testing of 76 steel columns and 95 lanterns along Bristol-Birmingham motorway.—See 14 Dec. issue.

12 Jan.—Worcestershire C.C. Provision and erection of standard and motorway signs and supply of traffic bollards for M5. County Surveyor, County Bldgs, Worcester.

13 Jan.—Brentwood U.D.C. Supply of (List 22) lamps for year. Engineer and Surveyor, Council Offices.

15 Jan.—Antrim C.C. Electrical installation, new Moyarget Primary School. Director of Education: K. A. MacCormac, 475-477 Antrim Rd, Belfast 15. Deposit £3.

15 Jan.—Dorset C.C. Supply of lamps for two years.—Advertised 14 Dec. issue.

17 Jan.—Huntingdon C.C. Supply and erection of 12 steel street lighting columns, fittings and gear for A1 Buckden By-pass roundabout. County Surveyor, Walden Hse, Huntingdon. Deposit £2.

19 Jan.—Aberdare U.D.C. Supply of (List 14) lamps for year. Engineer and Surveyor, Vestry Hall.

20 Jan.—Little Lever U.D.C. Rewiring and additional installations in 25 houses. Surveyor, High St, Little Lever, nr. Bolton.

26 Jan.—Brighton C.B.C. Supply and erection of two 2·5 m.g.d. submersible borehole pumps for Sompting. Chief Engineer, Water Dept., 12 Bond St. Deposit £3.

31 Jan.—Cheshire C.C. Supply of lamps. Applications to County Welfare Officer, County Hall, Chester, by above date.

1 Feb.—Ealing B.C. Electrical installation renewal in 255 dwellings at South Hanwell. Borough Engineer, Town Hall, W.5. Deposit £1. N.I.C. firms only.—Advertised in this issue.

2 Feb.—Londonderry R.D.C. Supply and installation of 500 g.p.m. at 365 ft head pumping plant for Carmony. Details from consulting engineers: W. D. R. and R. T. Taggart, 13 College Gdns, Belfast 9.

5 June—Campbeltown. N.A.T.O. Infrastructure contract, value £50,000.—Advertised 23 Nov. issue.

No date stated—Bristol. Applications invited for inclusion in select list for (No. 7) engineering, building and electrical sundries.—See 14 Dec. issue.

No date stated—Liverpool Hospitals. Electrical supplies for year. Supplies Officer, Rainhill Mental Hospital Management Committee, Rainhill, nr. Liverpool.

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 105 queries answered this week

"Thermowell" sink and heater units for vehicles—makers or? M.A.N.W.E.B.—Smiths Delivery Vehicles Ltd., Factory D17, Princes Way, Team Valley Trading Estate, Gateshead 11.

"EUK" incinerators—address for repairs? R.L.—Moorwood-Vulcan Ltd., 105 Princess St, Manchester 1.

"Climax" washing machines—agents for? H.H.—Warmsley Bros. (Import) Ltd., 216 Southampton Way, S.E.5.

"Geni" wall lamps—suppliers of? J.K.B.—Lustro Distributors Ltd., 4 Nile St, N.1.

"Donaldson" irons—makers of? N.S.H.E.B.—Donaldson Wireless Electric Irons, 31 Sloan St, Leith, Edinburgh 6.

"Rowe" convector heaters—makers of? M.E.B.—Rowe Bros. and Co, Ltd., Victoria Hse, Queen St, Exeter.

"Servis" washing machines—address for? P.L.—Wilkins and Mitchell Ltd., Darlaston, S. Staffs.

"Kingsway" vacuum cleaners—address for spares? S.E.C.—Remoco Ltd., 33 Priory Pk Rd, N.W.6.

"Tormax" pressure-operated door mats—agents for? G.C.T.—Automatic Doors Ltd., 1 Fitzroy St, W.1.

Acme Domestic Equipment Ltd.—address for? E.B.—Fort Matilda Wks, Eldon St, Greenock, Renfrewshire.

No date stated—N. of Scotland H.E.B. 30 MVA transformer for Charleston Substation, Dundee, and 60 MVA transformer for Glenagnes Substation, Dundee.—Advertised in 7 Dec. issue.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

27 Dec.—India. 87,510 yd power and control cables, together with boxes, joints, etc. (27 items). Superintending Engineer, Technical (Electrical), Tungabhadra Board, 10-2-3 A.C. Guards, Hyderabad. B.o.T. (ESB/37905/61).*

2 Jan.—Burma. Porcelain insulators; well glass lighting fittings and lampholders; 12 V batteries. Director-General, Union of Burma Purchase Board, St. John's Rd, Rangoon. B.o.T. (ESB/38220/1 and 2/61).*

2 Jan.—Pakistan. Requirements of Purchase Co-ordinating Officer, Posts and Telegraphs Directorate, Frere Rd, Karachi: (ESB/38217/61)* cadmium copper wire; (ESB/38214/61)* porcelain insulators; 14 Jan. (ESB/38218/61)* house wiring, switchboard and terminating cable polythene/p.v.c. insulated; 15 Jan.—copper wire (15 items). B.o.T. (ESB/3816/61).*

8 Jan.—Australia. 72,000 10 in. disc insulators. Secretary, S.E.C. of Victoria, 22-32 William St, Melbourne. B.o.T. (ESB/37950/61).*

8 Jan.—Australia. Ten 11 kV 350 MVA c.b's. Secretary, S.E.C. of Victoria, 22-32 William St, Melbourne. B.o.T. (ESB/37951/61).*

8 Jan.—Colombia. Water turbine, generator, switchboard, transformers, c.b's and lighting arrestors (13 items). Institute Nacional de Fomento Municipal, Departamento Commercial, Bogota. Bo.T. (ESB/37222/61).*

8 Jan.—Pakistan. Three 100 kW diesel generators. Chief Controller of Stores, P.E. Railway, Pahartali, Chittagong. B.o.T. (ESB/37249/61).*

9 Jan.—America. Four 138 kV c.b's. Bureau of Reclamation, Bldg 53, Denver Federal Center. B.o.T. (ESB/37937/61).*

9 Jan.—Australia. 6,000 disc insulators and 1,200 guy insulators. Secretary, Cairns Regional E.B., Box 358, P.O. Cairns, North Queensland. B.o.T. (ESB/37505/61).*

13 Jan.—Pakistan. 1,670 doz rolls of ¾ in. black adhesive tape for W.A.P.D.A. R. E. B. Willcox and Co., 36 Gt. St. Helens, E.C.3, are agents.

15 Jan.—India. 66 kV switchgear and accessories for Khaperkheda Power Station second extension. Controller of Stores, Maharashtra S.E.B., 284 Frere Rd, Bombay 1. B.o.T. (ESB/37982/61).*

16 Jan.—Pakistan. Iron-clad cutouts and fuse carriers for W.A.P.D.A. R. E. B. Willcox and Co., 36 Gt. St. Helens, E.C.3, are agents.

23 Jan.—Ceylon. 8,000 yd p.i.l.c. four-core 0·25 sq in. 1·1 kV grade cable and 5,000 yd three-core 0·10 sq in. 11 kV grade cable. Details from Crown Agents, 4 Millbank, S.W.1, reference QEE1/Ceylon Elec. Stores/512.

23 Jan.—India. 12,000 metre 11 kV, three-core p.i.l.c.d.s.t.a. cable. Chief Engineer (South), Stores Purchase Section, Punjab S.E.B., The Mall, Patiala. B.o.T. (ESB/37984/61).*

25 Jan.—Rhodesia and Nyasaland. One eight-panel 250 MVA 11 kV switchboard. Town Clerk, Bulawayo. B.o.T. (ESB/37511/61).*

1 Feb.—India. Insulators, o/h conductors and ground cables for 132 and 66 kV transmission schemes. Controller of Stores, Maharashtra S.E.B., 284 Sky-lark, Frere Rd, Bombay 1. B.o.T. (ESB/37979/61).*

7 Feb.—Australia. 200 mile s.c.a. conductor of 30-strand aluminium and seven-strand steel core. Secretary, Townsville Regional E.B., P.O. Box 626, Townsville, N. Queensland. B o.T. (ESB/37999/61).*

9 Feb.—India. 132 kV single-circuit transmission lines: (a) Chalisgaon-Dhulia; (b) Paras-Eldur-Parbhani. Controller of Stores, Maharashtra S.E.B., 284 Sky-lark, Frere Rd, Bombay 1. B.o.T. (ESB/37980/61).*

13 Feb.—Canada. One house unit water wheel turbine and generator for Grand Rapids Generating Station. Mr W. D. Fallis, General Manager, Manitoba Hydro, P.O. Box 815, Winnipeg. B.o.T. (ESB/37221/61).*

15 Feb.—Australia. Oscilloscopes, tape recorder, recording millivoltmeter, oscillograph, d.c. amplifier and digital recorder. Controller, Stores and Contracts, P.M.G. Dept., 114 Russell St, Melbourne, C.1. B.o.T. (ESB/37206/61).*

15 Feb.—India. 50,000 metre 660 V, four-core cables. Chief Engineer (South), Stores Purchase Section, Punjab S.E.B., The Mall, Patiala. B.o.T. (ESB/37986/61).*

15 Feb.—India. 132 and 66 kV substations for Paras, Risod, Eldur, Parbhani, Nanded, Parli, Jalna and Aurangabad. Controller of Stores, Maharashtra S.E.B., 284 Sky-lark, Frere Rd, Bombay 1. B.o.T. (ESB/37981/61).*

TRADE NOTES

Changes of address. The London office of Fielden Electronics Ltd. has moved to 181-183 Earls Court Rd, S.W.5. Telephone: Freemantle 7866.

The South Wales Divisional sales office of "Servis" washing machines is now at 58a Clive Rd, Canton, Cardiff. Telephone: Cardiff 25857.

Closure. As from 22 Dec. the A.E.I. Lamp and Lighting Co's southern sales region depot at 90 St. Aldates, Oxford, will be closed, and all business will be handled from the Reading depot.

Expansion. The new Locksbrook Rd factory of Hortsmann Ltd., at Bath, was formally opened recently.

Eire plant. The Standard Radio Corpn., of Tokyo, plans to set up a joint transistor radio manufacturing company with Waltham Electronics S.A., of Geneva, in Dublin. The joint firm will be called Waltham Electronics Ireland, and begin operating next February, producing 10,000 radios monthly.

New factory. Midlothian County Council have reached agreement with Norbury Instruments Co. Ltd., of Croydon, for the construction of a new factory at Newbattle.

BEAMA Contract Price Adjustment Formulae. *For Electrical Machinery and Equipment.* For purposes of calculating variations in: *(a)* "Rates of Pay"—the rate of pay for adult male labour at 15 Dec., 1961, shall be deemed to be 213s 6d; *(b)* "Cost of Material"—the index figure for materials used in the Electrical Machinery industry at 15 Dec., 1961, is 118·8* (184·3*).

For turbo-generating and Allied Plant. For purposes of calculating variations in: *(a)* "Rates of Pay"—the rate of pay for adult male labour as at 15 Dec., 1961, shall be deemed to be 213s 6d; *(b)* "Cost of Materials"—the index figure for materials used in the Mechanical Engineering Industry at 15 Dec., 1961, is 128·3* (192·8*). "Blast Furnace and Iron and Steel Melting and Rolling (1948 S.I.C. ref. 40/41)" 191·7. Other Steel Goods excluding tubes (1958 S.I.C. ref. 311/2), 130·6. The price of brass condenser tubes ¾ in. o/d 18 s.w.g. on 15 Dec., 1961, is 4s 1¼d per lb. *Provisional figure.

The figures in parentheses shown above relate to earliest list of wholesale price index numbers in which the year 1949 is taken as the base 100. For the other figures 1954 = 100.

CONTRACTS PLACED

Belper U.D.C. Extension of Group "A" sodium lighting along A6 Derby Rd, A.E.I. Lamp and Lighting Co. Ltd., £2,524.

Bristol C.C. Supply of transformers, Abacus Municipal Ltd.

Clowne P.C. Supply of 115 Group "A" steel columns, lanterns and gear, Abacus Municipal Ltd.

Darlington B.C. Electrical work in Branksome Secondary School, Cox-Walkers Ltd., £14,546.

Durham C.C. Electrical work in: Frosterley South County School, £1,221, and Wearhead County School, £1,088, J. Paterson (Darlington) Ltd.; Seaham Grammar Technical School, John Calvert Ltd., £16,964. Recommended.

L.C.C. Supply and installation of water heaters: in 405 dwellings on Becontree estate, F. J. Baynes and Co. Ltd., £22,090 1s 3d; in 273 dwellings on St. Helier estate, Ellis (Kensington) Ltd., £16,194.

Longbenton U.D.C.—Supply and erection of 144 Class "B" lighting units being Group IV of street lighting conversion scheme, Eleco Ltd. Recommended.

Manchester C.C. Electrical installation in new city abattoir, Jardine and Smith (Electrical Engineers) Ltd., £94,000.

Manchester Hospitals. Lift installation, Whitworth, Whittaker and Co., £4,866, and fire system, Associated Fire Alarms Ltd., £6,694, at Oldham General Hospital: rewiring of Congleton War Memorial Hospital, H. E. Charlesworth, £840; fire alarm installation in District General Hospital, Bolton, Hallams (Electrical Contractors) Ltd., £6,308; lift installation in Birch Hill Hospital, Rochdale, C. A. Percival, £10,601. Recommended.

Newcastle upon Tyne C.C. Electrical work in new swimming baths, estimated value £10,000, A. F. Jemison Ltd.

Newcastle Hospital Board. Electrical work in Stockton and Thornaby Hospital additions, Dove Ltd., £1,104; electrical and telephone installations in Cumberland Infirmary, Carlisle, James Scott and Co., (Electrical Engrs) Ltd., £4,383.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Airglow. 815,579. Class 11. Lighting and heating installations. Artic Fuse and Electrical Mfg. Co. Ltd., Elizabeth Ave, Birtley, Co. Durham.

EE in design. 814,746. Class 11. Fans, heaters and air-conditioning installations, etc. Emerson Electric Mfg. Co., 8100 Florissant Ave, St. Louis, Missouri, U.S.A.

Reliacons. 825,742. Class 9. Condensers. Erie Resistor Ltd., Millora Wks, Beevor Rd, South Denes, Great Yarmouth, Norfolk.

Wandleradio - Hitem. 818,754. Class 9. Cables for use in radio communications. Wandleside Cable Works Ltd., 106 Garratt La, Wandsworth, S.W.18.

Weathermaster. 818,720. Class 7. Clothes washing, drying and combined washing and drying machines. Bendix Home Appliances Ltd., Albion Wks, Kingsbury Rd, Birmingham 24.

Winsfield. 820,081. Class 9. Batteries, bell systems, cables, vacuum cleaners, condensers, conduits, switches, transformers, etc. 820,083. Class 11. Lighting, heating and cooking installations, etc., for domestic use. F. W. Woolworth and Co. Ltd., Woolworth Hse, 242-246 Marylebone Rd, N.W.1.

Windak. 824,638. Class 9. Heated clothing and foot muffs, etc. Baxter, Woodhouse and Taylor Ltd., Woodside, Poynton, Cheshire.

BUSINESS PROSPECTS

Aberdeen. N.E. Regional Hospital Board plan £1 million extension to Aberdeen Royal Infirmary.

Ashington. New factory planned for J. Hepworth and Son Ltd., Claypit La, Leeds 2.

Aylesbury. Regional Hospital Board given a contract to E. P. Gilkes and Son Ltd., Aylesbury, for extensions to operating theatre, Tindal General Hospital.

Barking. N.E. Metropolitan Regional Hospital Board, Eastbourne Terr, W.2, plan to develop Barking Hospital to double the present capacity.

Basingstoke. Extensions to cost £190,000 are proposed at Basingstoke High School for Girls.

Billericay. Proposed: factory and offices for J. Tann Ltd., to cost £250,000; contractors: Ronald Lyon Estates Co. Ltd., Hersham, Walton-on-Thames.

Birkenhead. Proposed: Christchurch primary school; quantity surveyors: Furbur and Sons, Cunard Bldgs, Liverpool 3.

Birmingham. Tenders being obtained for £6 million centre, Steelhouse La and Weaman St, for the Birmingham Post and Mail Ltd.; the cost includes the printing plant; plans include a 16-storey tower block; architect: J. D. Madin, 83 Hagley Rd, Edgbaston.

Bournemouth. Wessex Regional Hospital Board appoint Marshall and Ptnrs., Federal Hse, Down Pl, W.6, structural engineers for proposed lift, Royal Victoria Hospital, Westbourne.

Brighton. B.C. plan first instalment of Fawcett secondary boys' school, to cost £199,186.

Bristol. Factory extensions proposed by Poeton Industrial Plating Co. Ltd., Whitehorse St; quantity surveyors: Messrs Gleeds, 40 Corn St. University plan six new halls of residence to cost £2 million; each hall will accommodate 220 students. Development proposed, Baldwin St and St. Nicholas St, by Clerical, Medical and General Life Assurance Soc., 16 Clare St, Bristol 1.

Brixham. Devon C.C. plan secondary school to cost £200,000; architect: R. N. Guy, 97 Heavitree Rd, Exeter.

Cardiff. C.C. propose Treorchy School; architects: Sir Percy Thomas and Son, 11 Cathedral Rd.

Cheltenham. Ford and Weston Ltd., 34 Imperial Sq, contractors for new printing works for Taylor Young (Printers) Ltd. and C. J. Young (Colour Printers) Ltd.

Coventry. Planned: factory and offices, Torrington Ave, for Carter Stevens Automation Ltd., 188 Fletchampton Highway.

Croydon. Factory and offices proposed by J. Richards and Sons Ltd.; cost: £70,000; contractors: R. Hart and Sons Ltd., 121 Victoria St, S.W.1.

Darwen. Lancs C.C. plan secondary school at Knowle Fold; County Architect, Preston.

Desborough. U.D.C. propose 32 dwellings, Rushton Rd estate; Surveyor. U.D.C. propose 14 Class "B" street lights costing £660, Gladstone St, Nichol St; Surveyor.

Doncaster. Sheffield Regional Hospital Board propose two new wards, St. Catherine's Hospital, costing total of £110,000. B.C. propose 65 old people's bungalows, Intake, and 91 on various sites; Surveyor.

Durham. C.C. propose new school for maladjusted boys, Redworth Hall, to cost £97,653, figure includes proposed residential block, Windlestone Hall.

Eastbourne. Proposed by Pimms Ltd., 88 Bishopsgate, E.C.2, rebuilding first to sixth floors of east wing, Cavendish Hotel.

East Riding C.C. Tender: County primary school, Cottingham; architect: G. L. Thompson, 46a Coney St, York.

Exeter. Selected contractors to be asked early next year to tender for second stage of University's £1 million expansion scheme; architect: Sir Basil Spence, 1 Fitzroy Sq, W.1.

Feltham. Hallmark Securities Ltd., 9 Wimpole St, W.1, propose £1,500,000 development at High St.

Govan. Proposed by Western Regional Hospital Board: two new departments on a seven-acre site adjoining Glasgow Southern General Hospital.

Halifax. Leeds Regional Hospital Board, Harrogate, have a £70,628 scheme for resiting X-ray department, Halifax Infirmary.

Harrow. Bernard Sunley and Sons Ltd., 26 Berkeley Sq, W.1, propose office block and car park to cost £260,000, Station Rd.

Herts. C.C. propose replacement of John Hampden Secondary School, East Barnet; cost: £233,315.

Huntingdon and Godmanchester. B.C. award £229,800 contract for 99 dwellings to F. B. Thackray and Co. Ltd., St. Peter's Hill, Huntingdon.

Ipswich C.B.C. Tender: stage four of new Civic College; architects: H. Johns, Slater and Haward, 32 Foundation St.

Leatherhead. U.D.C. propose provision of Class "A" lighting, Dorking Rd area.

Leeds. New building, Westgate, proposed by Yorkshire Factoring Co. Ltd.; contractors: P. Kiernam Ltd., Shadwell. Regional Hospital Board, Harrogate, plan extensions to St. James's Hospital.

Leicester. Estates Property Investment Co. propose 11-storey block of shops/offices, Charles St; cost: £450,000; architects: Andrews, Emmerson and Sherlock, 63 Dean St, W.1.

Liverpool. Proposed: factory extensions, Barlows La, for E. S. and A. Robinson Ltd.; contractors: R. Costain and Sons (Liverpool) Ltd., Barlows La, Liverpool 9.

London. Warehouse and offices proposed at Arcola St, E.5, for Bally's Shoe Co. Ltd.; cost: £200,000; quantity surveyors: House and Shrimpton, 4 Gt. Queen St, W.C.2. Proposed: factory, Hartwell St, E.8, for A. Webber and Son Ltd.; contractors: G. Savitt and Sons Ltd., 20 Brewer St, W.1. Morgan Crucible Co. Ltd., Battersea Church Rd, S.W.11, propose offices and showrooms to cover 60,000 sq ft, Battersea Church Rd, S.W. British Iron and Steel Research Assoc., 11 Park La, W.1, plan new research laboratories, Battersea Park Rd, S.W. Proposed by Co-operative Planning Ltd., architects, 73b South Side, Clapham Common, S.W.4, 189 dwellings, Isle of Dogs, Poplar, E. Proposed by Erno Goldfinger, architect, 69 Piccadilly, W.1, flats 11 or 20 storeys in height, Avenue Rd, St. John's Wood, N.W. Contract for proposed £360,000 hotel, Lisson Gro, St. Marylebone, N.W.1 placed with Halse and Sons Ltd., Woolwich High St, S.E.18. Planned: hotel and shopping centre, Kensington High St; main contractors: Tersons Ltd., Dollis Pk, N.3. D. Du R. Aberdeen, 19 Southampton Pl, W.C.1, architect for proposed "Swiss Centre," New Coventry St, Wardour St, Lisle St and Leicester St, W.C.2; proposals include shops, restaurants, exhibition and offices. Adams, Holden and Pearson, architects for a new medical school proposed at John Islip St, Westminster, S.W.1.

Luton. Extensions proposed at Maternity Hospital may cost £100,000; architect: F. A. C. Maunder, N.W. Metropolitan Hospital Board, 40 Eastbourne Terr, W.2.

Lytham St. Annes. Extensions to factory, Preston Rd, proposed by Dudley Hill Engineering Co. Ltd.

Malden. Proposed, Grafton Rd, shopping parades, pedestrian square and a ten-storey office block; promoters: Apex Properties Ltd., 20 Knightsbridge, S.W.1.

Manchester. C.C. proposes remaining instalments of reconstruction of Mobberley Approved School for Boys; cost: £363,866. Metrovincial Properties, 15a Hay Hill, W.1, plan to redevelop Portland St area, at an expected cost of £20 million.

Poole B.C. Tender: Extensive alterations to Girls' County Secondary School, Ashley Cross, Parkstone; Architect.

Port Talbot B.C. Tender: 100 dwellings, Baglan; Engineer.

Preston. Manchester Regional Hospital Board, Cheetwood Rd, Manchester, propose extensions, Preston Royal Infirmary.

Reading. Proposed: 47 houses, Lower Henley Rd, for Doughty Developments Ltd. 96 flats and maisonnettes, Bath Rd, for Aneuex Investments Ltd. 61 dwellings, 21 flats, New Hill La, for McManus and Co. Ltd., North Town estate, Maidenhead. University authorities propose chemistry teaching and research laboratories; quantity surveyors: H. H. Turner and Son, 19 Queen Anne's Gate, S.W.1.

Redhill. Proposed: canteen and office block, Holmethorpe Ave; contractors: Bridge Walker Ltd., 91 Effra Rd, S.W.2.

Rotherham. Proposed: main plant building, workshops, storage, Aldwarke La, for British Oxygen Co., Bawtry Rd. Proposed: store with offices over, Herringthorpe Valley Rd and Brecklands; and retail store, shops, with offices over, Wickersley Rd, for Central and Provincial Properties Ltd., 13 New Bridge St, E.C.4.

Runcorn. Imperial Chemical Industries Ltd. plan expansion scheme to cost about £1,500,000.

St. Ives. B.C. propose improvements to 42 council houses; Surveyor, St. Ives, Hunts.

Salford. Manchester Regional Hospital Board propose installation of bed lift, Hope Hospital.

Sandwich. Proposed by Petbow Ltd. 90,000 sq ft extension to factory, Richborough.

Scunthorpe. Quibell and Hardy Ltd., Scunthorpe, awarded £500,000 contract for extensions to Scunthorpe War Memorial Hospital.

Sedgefield. Proposed: 150 houses, Spring La, by Bainbridge and Son, 44 High Row, Darlington.

Sedgley. Proposed at Garden Walk estate, 123 dwellings, by Gregory Housing Ltd., Farncombe Rd, Worthing.

Shipley. Proposed: extensions for Hepworth and Grandage Ltd., Hurst Wood Wks, Saltaire; contractors: William Airey and Son Ltd., Eidon Hse, Leeds 2.

Shropshire. C.C. plan ambulance stations and staff quarters to cost £108,100 at Bridgnorth, Donnington, Craven Arms and Prees; County Architect, Shrewsbury.

Smethwick. B.C. propose 568 dwellings on several sites.

Southampton. Industrial and Investment Services Ltd., 129 Finsbury Pavement, E.C.2, plan shops, a bowling centre and offices, Bitterne Rd, and Ritz Cinema, Bitterne. Wessex Regional Hospital Board appoint Gutteridge and Gutteridge, 45 Westwood Rd, architects for proposed lift, Royal South Hants Hospital.

South Shields. Large factory proposed, Simonside industrial estate, by the Industrial Estates Management Corpn.; contractors: Cummings, Matamba Terr, Sunderland. B.C. propose 107 dwellings, Reading Rd; Engineer, Town Hall.

S. Wales. Extensions to factory to cost £60,000 proposed by Dare Inglis Products Ltd.; contractors: E. Taylor and Co. Ltd., Treforest Industrial Estate, Pontypridd.

Spennymoor. Bell and Ridley Ltd., North Rd, Durham, contractors for proposed Remploy Ltd. factory.

Stanley. U.D.C. award contract for 84 houses, Lintz estate, to T. Armstrong Ltd., Robson St, Newcastle.

Stirlingshire. Proposed: 2,000 houses north of Glasgow, for Mactaggart and Mickel Ltd., 107 West Regional St, Glasgow C.2.

Stockton. Martad Investments Ltd. propose seven-storey flats with 84 dwellings, Hartburn La; Solicitors: M. L. Cohen and Co., 10 Yarm La.

Stonehaven. Kincardine C.C. propose site at Ury Park for £300,000 secondary school to replace Mackie Academy.

Tarvin. G. C. Shone and Co. Ltd., Oak Cottage, Picton Gorse, Mickle Trafford, propose 44 houses and 22 bungalows, Hockenhull La.

Thorne. R.D.C. propose between 100 and 200 houses in 1962; Surveyor.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

Anglo-American Electrical and Carburettor Services Ltd., 134 Norwood Rd, Tulse Hill, S.E.24. Nom. cap.: £7,500. Dirs.: John C. B. Seage and Thomas G. Wilks.

Brookes Crystals (1961) Ltd., Cornhill Factory, Ilminster, Som. Manufacturers of instruments incorporating piezo electric materials of all kinds, electronic apparatus, etc. Nom. cap.: £100. Dirs.: Archibald W. C. Gooch, Cyril P. Millsom, B. W. Brookes and L. A. Housego.

D. H. Carson and Co. Ltd., 19-23 Oxford St, W.1. Electrical goods manufacturers and dealers, etc. Nom. cap.: £3,000. Dirs.: David H. Carson, Henry Carson, Fay Carson and Estelle Carson.

Collings (Aldridge) Machinery Co. Ltd., 1 Mortord Rd, Aldridge, Staffs. Dealers in and factors, merchants, exporters and importers of engineering, electrical and gas appliances, etc. Nom. cap.: £6,000. Permanent dirs.: Cyril Collings, William T. Andrews, Iris E. Collings and Phyllis Andrews.

Creed (Rentals) Ltd. To let on hire telecommunication, data processing and automation equipment, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: R. G. A. Youard and F. J. Wilson, 18 Austin Friars, E.C.2.

Dubesco Laboratories Ltd., St. Joseph's Close, Hove, Sussex. Manufacturers of and dealers in electrical and general engineering equipment, etc. Nom. cap.: £100. Dirs.: Percival F. D. Cornish and Evelyn J. Lethbridge.

Electrorght Ltd., 7 All Saints Passage, Cambridge. Manufacturers of and dealers in artificial lighting apparatus, etc. Nom. cap.: £100. Dirs.: Hubert Wale, Reginald A. Wale, Godfrey R. W. Wright and Hedley J. Hodge.

Gasson and Green Ltd., 8 Hamslands, Horsted Keynes, Sussex. Manufacturers of and dealers in radio, electrical and mechanical apparatus, etc. Nom. cap.: £100. Dirs.: James T. M. Gasson and David Green.

H.C.D. Research Ltd. Electronic, electrical and communication engineers, etc. Nom. cap.: £5,000. Dirs.: Patricia Hooper, Christopher A. Henn-Collins, Ormus C. Lavenport and Frank F. Legg. Subs.: Norman A. Bond and Miss J. Agar, 7 Lincoln's Inn Fields, W.C.2.

Heco Fluorescent Ltd., 52-4 Gray's Inn Rd, W.C.1. Lamp manufacturers and dealers, etc. Nom. cap.: £500. Dirs.: Henry Gehr and Erica Gehr.

John Herbertson Ltd. Electrical engineers, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Dorothy M. Graeme and P. G. Graeme, 61 Fairview Rd, Gillingham.

Hills-McCanna Ltd. To carry on business of general engineers, electronic device manufacturers and dealers, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Elizabeth M. Rowe, 6 Buxton Dr, New Malden, Surrey; and W. J. Sykes.

Howard Bros. (Darlaston) Ltd., 45 Welsh Back, Bristol. Television and electrical engineers, etc. Nom. cap.: £1,000. Dirs.: Martin F. Gibbons, Chas. P. Gibbons, Kenneth J. Howard and Frederick G. Howard.

George Hulme (Stockport) Ltd., 4 Castle St, Stockport, Ches. Manufacturers of and dealers in electrical goods, etc. Nom. cap.: £3,000. Dirs.: George Hulme and Susan Hulme.

Markon Engineering Co. Ltd. Electrical and mechanical engineers, etc. Nom. cap.: £500. Dirs.: not named. Subs.: Wilfred H. Kelham, 49 Broad St, Stamford, Lincs; and Jeremiah P. Hegarty.

McLachlan and Howley Ltd., 16 High St, Albrighton, nr. Wolverhampton. To take over the business of electrical engineers and contractors carried on as "McLachlan and Howley" at Albrighton, etc. Nom. cap.: £6,000. Dirs.: Nora A. L. McLachlan and Philip G. Howley.

I. and E. Morton (Electricals) Ltd., 39 Bondgate Without, Alnwick. Nom. cap.: £1,000. Dirs.: Emanuel W. W. Morton and Ann Morton.

Pantrima Electrics Ltd., 713 Imperial Hse, Kingsway, W.C.2. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Shirley Hart and Averill Hart.

Pringle Products (Electrical) Ltd., 69-71 Praed St, W.2. Nom. cap.: £500. Dirs.: to be appointed by subs. Subs.: J. D. Berman and Fazlur Rd. Usmani.

Albert E. Sara Ltd., 83-5 St. Mary Rd, E.17. Electrical goods manufacturers and dealers, etc. Nom. cap.: £10,000. Dirs.: Albert E. Sara and Doreen R. Sara.

Stockblock Ltd., 10 Corringham Rd, Wembley Pk, Middx. Electricians, mechanical, radio and general engineers, etc. Nom. cap.: £100. Dirs.: Manfred E. Braynis and Jean M. Braynis.

Survey and Inspection Service Ltd., 46 Old Bond St, W.1. To provide technical service for the survey, inspection, testing, supervision of and consultants on engineering equipment and electrical components, manufacturers and producers of chemical engineering, pipe line and atomic energy projects, etc. Nom. cap.: £100. Dirs.: Frederick Sullivan and George Smith.

Willowfield Systems Ltd., 7 Staple Inn, W.C.1. Mechanical and electrical engineers, etc. Nom. cap.: £1,000. Dirs.: F. E. Hupfield and Mrs E. E. Hupfield.

MEETINGS TO NOTE

THURSDAY, 21 DEC.

INSTITUTION OF PLANT ENGINEERS (Blackburn). "The Merits of Various Heat Generation and Distribution Systems," R. A. Wiggans. Castle Hotel, Blackburn. 7.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Grangemouth). "Instrumentation of Space Vehicles," Dr A. E. Roy. Leapark Hotel, Bo'ness Rd. 7 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS (W. Midlands). "The R.R.E. Radio Telescope Interferometer," H. Gent. Birmingham University. 6.15 p.m.

A.S.E.E. (S. London). "Manufacture of Foodstuffs," R. B. O. Harwood. Greyhound Hotel, Croydon. 8 p.m.

THURSDAY, 28 DEC.

INSTITUTE OF PLASTICS (Midlands). "Survey of New Developments in Resin," H. R. Everard. James Watt Memorial Institute, Gt. Charles St, Birmingham 3. 6.30 p.m.

FRIDAY, 29 DEC.

R.S.A. Juvenile Lecture: "Machines That Think," A. D. Booth. John Adam St, Adelphi, W.C.2. 2.30 p.m.

TUESDAY, 2 JAN.

I.E.E. (N. Midlands). "Progress in Oil-filled Cables and Their Accessories," A. N. Arman, F. J. Miranda and G. R. Bishop. Leeds and County Conservative Club, South Parade, Leeds 1. 6.30 p.m.

I.E.E. (S. Midlands). Faraday Lecture: "Expanding Horizons in Communications," D. A. Barron. Birmingham Town Hall. 7 p.m.

GAZETTE ANNOUNCEMENTS

COMPANIES ACTS

Durham Electrical (Wholesalers) Ltd. Mr R. A. Hawken, Bank Chmbrs, 1 John St, Bedford Row, W.C.1, appointed liquidator at extraordinary general meeting on 18 Oct. for the purpose of voluntarily winding-up.

J. Southern and Co. Ltd. General meeting of members to be held at 4-7 Chiswell St, E.C.1, on 10 Jan., at 11 a.m., for the purpose of receiving an account of the winding-up proceedings.

Jonmil Bldg Developments Ltd. Winding-up order dated 4 Dec.

Denfield Electrical Co. Ltd. Mr G. A. Wale, Walter Hse, 418-422 Strand, W.C.2, appointed liquidator at extraordinary general meeting on 1 Dec. for the purpose of voluntarily winding-up.

BANKRUPTCY ACTS

Receiving Orders

Portsmouth. E. W. Gascoigne and T. Nash, appliance distributors, formerly carrying on business as Regal Electrics at 53 High St, Fareham. Receiving order dated 4 Dec.

Chesterfield. B. Holmes, electrical goods dealer, formerly carrying on business as Holmes Electric at Electrical Workshops, off Institute La, Alfreton, and at 37 Market St, Clay Cross. Receiving order dated 6 Dec.

First Meetings and Public Examinations

Truro and Falmouth. F. L. Bell, electrical dealer and contractor, formerly carrying on business at 127 Trelowarren St, Camborne, Cornwall. Public examination: 2.30 p.m., 6 April, at Town Hall, Truro.

Burton upon Trent. P. K. W. Toon, electrical contractor, carrying on business at 47 Hawfield La, Winshill. Public examination: 10.30 a.m., 16 Jan., at County Court Hse, 165 Station St, Burton upon Trent.

Halifax. J. Priestley and D. Hutchinson, appliance dealers and repairers, carrying on business as Electrical Enterprises at 90 Southgate, Elland, and 110 Commercial St, Brighouse. Public examination: 10.30 a.m., 13 Feb., at County Court, Prescott St, Halifax.

Birmingham. Mitchell Electric Co., makers of Meco appliances, carrying on business at 88-90 Tennant St, Birmingham 15. First meeting: 10.45 a.m., 21 Dec., at Official Receiver's Office, Somerset Hse, 37 Temple St, Birmingham 2; and public examination: 10.15 a.m., 31 Jan., Court Hse, Corpn. St/Newton St, Birmingham 4.

Appointment of Trustees

Aylesbury. A. C. Hart, radio and electrical engineer, carrying on business at 256 High St, Berkhamsted. Mr R. A. Hawken, Bank Chmbrs, 1 John St, W.C.1, appointed trustee as from 4 Dec.

Northampton. J. B. English, electrical engineer, carrying on business as W.M.S. (Corby) at 1 Harrogate Court, Corby. Mr R. A. Palmer, 45 Sheep St, Northampton, appointed trustee as from 5 Dec.

Intended Dividends

Bournemouth. K. R. Cockerton, carrying on business as Bournemouth Domestic Appliance Services at 206 Herbert Ave, Parkstone. Last day for receiving proofs for intended dividend: 22 Dec., by trustee: M. J. Bright, 121 Commercial Rd, Southampton.

Leeds. H. G. Duff, radio, television and electrical dealer, formerly carrying on business at 4 Halliday Grove, at 7 Canal Rd and at 8 Dodsworth Court. Last day for receiving proofs for intended dividend: 2 Jan., by trustee: N. Saddler, Pearl Chmbrs, East Parade, Leeds 1.

Applications for Discharge

Newcastle upon Tyne. S. I. Rae, electrical contractor, carrying on business at 1 Ashburton Rd, Gosforth. Application for discharge to be heard at 10.30 a.m., on 29 Jan., at Court Hse, 56 Westgate Rd, Newcastle.

High Court of Justice. A. S. Evans, electrical contractor, formerly carrying on business at "Wayside," West Rd, Bridport, Dorset. Order made on application for discharge: discharged as from 26 July, 1962.

Dividend

Liverpool. E. S. Williams, retailer, carrying on business at 152 Lodge La, Liverpool 8. Dividend per £: 1s 7d, payable at 11-13 Victoria St, Liverpool, on 21 Dec.

ATTENTION

Chilton Electric Products Ltd. wish to make it clear that they have no connection with the Chiltern Electrics Ltd. for whom a liquidator has been appointed. See ELECTRICAL TIMES, page 831, 30 Nov.

Take a letter

Miss Sims

The perfect secretary, aren't you, Miss Sims. Brisk, efficient and businesslike. You know how to get the best out of your typewriter. Just as the typewriter manufacturer knows how to put the best *into* it—pressure die castings, for instance.

Pressure die castings offer manufacturers high quality components at remarkably low cost in a variety of pleasing finishes. And the massive scale of production that can be achieved helps everyone to enjoy a high standard of living.

Wolverhampton pressure die castings in zinc and aluminium point to progress in a big way.

Your enquiries would be welcomed.

THE WOLVERHAMPTON DIE CASTING COMPANY LIMITED

GRAISELEY HILL, WOLVERHAMPTON TELEPHONE: WOLVERHAMPTON 23831/7

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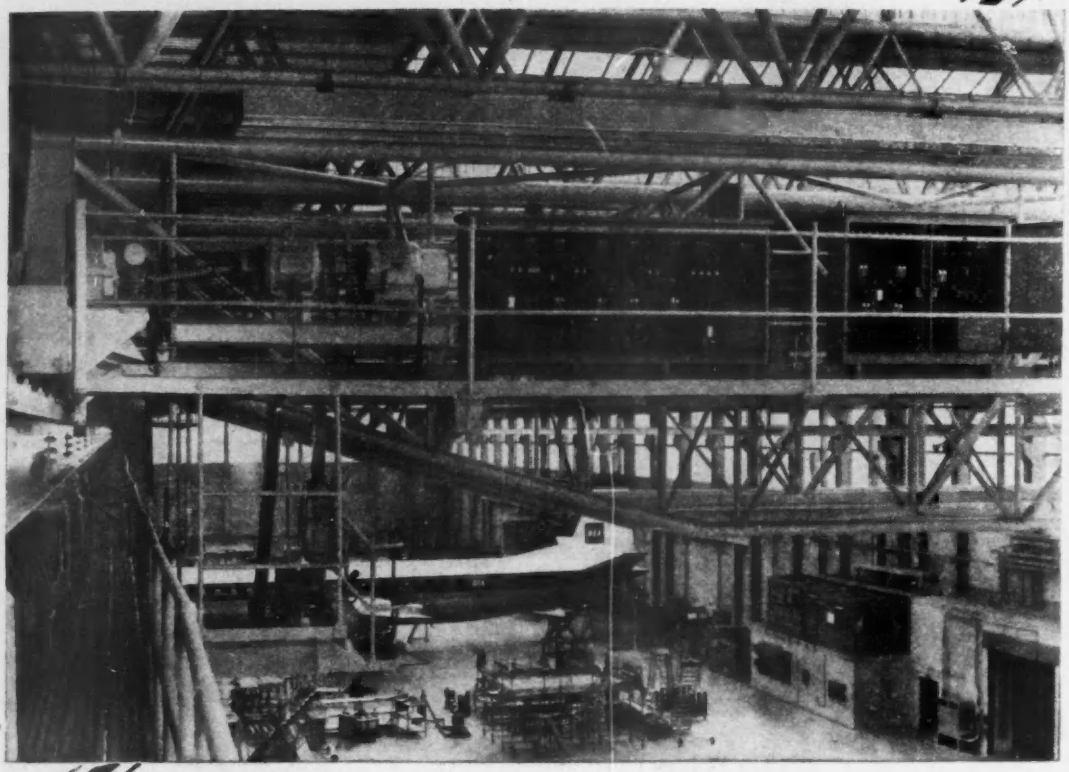

BEA ENGINEERING BASE, LONDON (Heathrow) AIRPORT

RELIABILITY must always be the main consideration in air travel, not only from the safety point of view but also from the economics of aircraft maintenance.

The combination of E.M.B. Contactor Control Gear on this carruthers crane at the B.E.A. Engineering Base at London Airport takes care of this aspect so far as crane handling is concerned.

The E.M.B. MICROsens used in conjunction with the control gear give the creep speeds so necessary when dealing with this type of refit.

E.M.B. Co. Ltd.

WEST BROMWICH
Phone: WESt Bromwich 1171
ENGLAND

CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

BOROUGH OF EALING

Renewal of Electrical Installations of 255 Council Dwellings at South Hanwell.

TENDERS are invited from approved N.I.C.E.C. Contractors for the above-mentioned work. Specification and Tenders from the Borough Engineer, Town Hall, Ealing, W.5, on receipt of deposit of £1 returnable on receipt of a bona fide tender. Closing date: 1 Feb., 1962.

E. J. COPE BROWN,
Town Clerk.
(D 163)

APPOINTMENTS VACANT

SOUTH OF SCOTLAND ELECTRICITY BOARD

Edinburgh and Borders Area

THIRD ASSISTANT ENGINEER

(METERS, TEST AND PROTECTION)

SALARY: N.J.B. Schedule A, Class L, Grade 10, £1,190/£1,325 p.a.

Applications, on the standard form, obtainable from the undersigned, should be submitted not later than 15 Jan., 1962.

Conditions of service in accordance with the N.J.B. Agreement for the Electricity Supply Industry: the successful candidate, subject to satisfactory evidence of health, will require to become a contributor to the Board's Superannuation Scheme.

Applicants should hold the H.N.C. (Electrical Engineering) or equivalent, and have some experience in commissioning new substations and routine testing and maintenance of protective gear.

The successful applicant will require to reside within a reasonable distance of Area Headquarters, Edinburgh.

C. H. A. COLLYNS,
Manager.

52 Melville St,
Edinburgh 3. (D 145)

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Region

West Midlands Division

FOURTH ASSISTANT ENGINEER

SYSTEM OPERATION DEPARTMENT

APPLICATIONS are invited for the appointment of Fourth Assistant Engineer in the System Operation Department, Birmingham. N.J.B. service conditions, superannuable appointment. Salary within Schedule B, Class L, Grade 11, £920/£1,245 per annum.

The duties of the post are mainly statistical, and applicants should have had a sound technical education to Ordinary National Certificate as a minimum, and preferably have had power station experience.

Apply, quoting Vacancy No. 309/61 MR on application form AE6, available from the System Operation Engineer, Warwick Hse, Redhill Rd, West Heath, Birmingham 30, to be completed and returned by 1 Jan., 1962. (D 156)

THE NORTH WESTERN ELECTRICITY BOARD

(a) THIRD ASSISTANT ENGINEER

(SENIOR CHARGE ENGINEER)

(b) FOURTH ASSISTANT ENGINEER

(CHARGE ENGINEER)

OPERATION SECTION

SUB-AREA ENGINEERING DEPARTMENT

MANCHESTER

APPLICATIONS are invited for the above posts in the Sub-Area Central Control Room.

Post (a): The duties include operational control of a large E.H.V. transmission and distribution system interconnecting a number of Power Stations by supervisory control and system switching.

Post (b): The duties include assisting the Senior Charge Engineer in the above work.

The Engineers appointed will be required to perform shift duties. Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary Scales:

Post (a): £1,275/£1,410 p.a. plus 10% Shift Allowance, Grade M.10.

Post (b): £1,115/£1,245 p.a. plus 10% Shift Allowance, Grade M.12.

N.J.B. Conditions.

Applications on forms to be obtained from the Manager (Staff Vacancy), No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester 2, P.O. Box 493, and returned to him by 4 Jan., 1962. (D 150)

28 DECEMBER ISSUE

Advertisements for insertion in the 28 Dec. issue should be received not later than 10 a.m., Friday, 22 Dec.

UGANDA GOVERNMENT

Public Works Department

INSPECTOR OF WORKS (ELECTRICAL)

REQUIRED. Appointment on contract for one tour of 21-27 months in first instance. Salary according to age and experience in scale (including Inducement Pay) rising to £1,671 a year. Gratuity 25% of total salary drawn. Outfit allowance £30. Children's Education allowances. Free passages. Liberal leave on full salary.

Candidates should be 29-40 years of age, and must possess at least O.N.C. (Electrical) or equivalent qualification. They should also have served a full apprenticeship and had subsequent experience in maintenance of Industrial electrical equipment and large installations. They must be fully conversant with U.K. Home Office Electricity Rules, Electricity Regulations under the Factories Act and those of the Electrical Commissioners.

Apply to CROWN AGENTS, 4 Millbank, London S.W.1, for application form and further particulars, stating age, name, brief details of qualifications and experience and quoting reference M2/50987/EE. (D 152)

CENTRAL ELECTRICITY GENERATING BOARD

North Eastern Region

THIRD ASSISTANT ENGINEER

(SUBSTATIONS AND CABLES)

REGIONAL TRANSMISSION PROJECT BRANCH

APPLICATIONS are invited from engineers to supervise the work of contractors engaged in the installation of electrical plant including cables at 132 kV, 275 kV and 400 kV Substations in the Region.

Candidates should have had previous experience on both the construction and maintenance of substation equipment, but applicants with experience of either will be considered.

It is desirable that the candidates should have qualifications leading to corporate membership of the Institution of Electrical Engineers.

The salary for the appointment will be in accordance with the National Joint Board Agreement, Grade 8, Class K (£1,145/£1,410 per annum).

Forms of application may be obtained from the Regional Personnel Officer, Central Electricity Generating Board, North Eastern Region, 1 Whitehall Rd, Leeds 1, to whom they should be returned to arrive not later than 1 Jan., 1962. (D 146)

SOUTH EASTERN ELECTRICITY BOARD

ASSISTANT DISTRICT ENGINEER

CENTRAL SUSSEX DISTRICT

SALARY: £1,040/£1,165 per annum in accordance with N.J.B. Class F, Grade 7. Applicants should be qualified engineers and have had training and experience in planning, construction, operation and maintenance of underground and overhead distribution systems up to 33 kV. The district is 298 sq miles in area and the units sold in 1960-61 were 199 million. It is expected that the district classification will be raised to G in 1962 or 1963. Transport will be provided or the successful candidate may elect to use his own car on Board's business with the appropriate allowance. Rented living accommodation may be offered to the successful candidate.

Applications, quoting ET and naming two referees, to District Manager, Seeboard, Electra Hse, Church Rd, Haywards Heath, Sussex, by 3 Jan., 1962.

GEORGE WRAY,
Secretary.
(D 151)

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Region

West Midlands Division

ASSISTANT ENGINEER (OPERATION)

DRAKELOW "B" POWER STATION

APPLICATIONS are invited for the appointment of Assistant Engineer (Operation) at Drakelow "B" Power Station, nr. Burton-on-Trent. N.J.B. service conditions, superannuable appointment, salary within Schedule A of the Agreement, Grade L.10, £1,190/£1,325 per annum, plus 10% for shift duties.

Applicants should have received a sound technical training and practical experience in the operation of steam generating plant and main switchgear, and a knowledge of P.F. firing is desirable. Appropriate technical qualifications would be an advantage.

Apply, quoting Vacancy No. 304/61 MR on application form AE6, available from the Station Superintendent, Drakelow Power Station, nr. Burton-on-Trent, to be completed and returned by 1 Jan., 1962. (D 155)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 46s. per inch, and all other classified advertisements at 3s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

CENTRAL ELECTRICITY GENERATING BOARD

Southern Division

South Western Region

SEC/3.177.

FOURTH ASSISTANT ENGINEERS

TRANSMISSION DISTRICTS

CANDIDATES should have had experience of work on protective gear including testing, and a knowledge of modern switchgear is desirable.

Alternative vacancies may also be available in some Districts for those with experience in the operation and maintenance of transforming substations and grid lines up to 275 kV.

Preference will be given to those possessing a Higher National Certificate or equivalent qualifications.

The Districts are situated at Aldershot, Nursling (nr. Southampton), Portsmouth, Reading, Poole, Swindon and Uxbridge. Successful applicants will be appointed to one of these Districts.

Salary: N.J.B. Scale 8, Grade K.11, £900/£1,165 per annum.

Special application forms obtainable only from Personnel Officer (Southern), 111 High St, Portsmouth, should be returned by 2 Jan., 1962. (D 172)

THE SCOTTISH GAS BOARD

Westfield Works

INSTRUMENT ENGINEER

APPLICATIONS are invited from Engineers with appropriate qualifications and experience for the post of Instrument Engineer at the Lurgi Pressure Gasification Plant, Westfield, Fife.

The salary will be within the range £975/£1,260 per annum, with initial placing according to qualifications and experience.

The Instrument Engineer will be responsible to the Works Engineer for the maintenance and satisfactory operation of all instruments on the works, including process-control and recording equipment.

The post is pensionable and the successful applicant will be required to pass a medical examination.

Applications, stating age, and giving details of education, training, qualifications and experience, together with the names of two referees, should be sent to the undersigned within ten days of the appearance of this advertisement.

A. T. HERD,
Secretary.

26 Drumsheugh Gdns,
Edinburgh 3. (D 168)

CENTRAL ELECTRICITY GENERATING BOARD

South Western Region

Regional Electrical Department

CONTRACTS ENGINEERS

APPLICATIONS are invited from Electrical Engineers for posts as Contracts Engineers in the Regional Electrical Department, situated at Bradford Hse, St. Stephen's Ave, Bristol 1.

The successful applicants will be responsible for the general engineering of a group of High Voltage Substation Projects, including the preparation of technical enquiries and the assesment of tenders for 132 kV and lower voltage switchgear, transformers, cables and overhead lines, as well as for the control, protection and metering equipments. Responsible experience in some of these branches of engineering and adaptability to the others are essential.

Corporate membership of the Institution of Electrical Engineers would be an advantage.

The salary for the posts will be within the Scales £1,415/£1,720 per annum and £1,320/£1,610 per annum.

Applications on Form AE6/ACT, obtainable from the Regional Personnel Officer, Oakfield Hse, Oakfield Grove, Clifton, Bristol 8, should be returned by 5 Jan., 1962. (D 173)

MIDLANDS ELECTRICITY BOARD

DRAUGHTSMAN

REQUIRED in the North West District of the Birmingham Area to deal with the preparation of plans and sketches and the compilation of Cartographic Mains Records. Salary: £780/£880 per annum (N.J.C. Grade 3). Superannuable. Apply, by letter, within seven days, stating age, experience and present position to Emil Braathen, Area Manager, Midlands Electricity Board, 14 Dale End, Birmingham 4.

F. W. CATER,
Secretary.
(D 162)

SEVERAL DRAUGHTSMEN

are required for the mechanical developments of electric motors, a.c. and d.c., shafts, frames, end brackets, etc. Experience of flameproof motor design an advantage. Good wages; pension scheme; 5-day week.—Apply to Box No. 8511, Electrical Times. (D 106)

BRITMAC ELECTRICAL COMPANY LIMITED

Manufacturers of High Class Electrical Accessories

require Representative for the Counties of Cumberland, Westmorland, Lancashire, Cheshire and North Wales.

Candidates must have good connections with Consulting Engineers, Local Authorities, Electrical Contractors and Wholesalers.

Remuneration by Salary, Commission and Expenses. Company car provided. Contributory Pension Scheme.

Reply giving details of age and full particulars of experience, also salary required to:
BRITMAC ELECTRICAL CO. LTD.,
Britannia Works, Wharfdale Rd, Tyseley,
Birmingham 11. (D 107)

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Region

West Midlands Division

SHIFT CHARGE ENGINEER

DRAKELOW "A" POWER STATION

APPLICATIONS are invited for the appointment of Shift Charge Engineer at Drakelow "A" Power Station, nr. Burton-on-Trent. N.J.B. service conditions, superannuable appointment, salary within Schedule A, Grade J6, £1,350/£1,500 per annum, plus 10% shift allowance.

A sound technical training and practical experience in the operation and maintenance of steam generating plant and main switchgear in a large modern power station are required, also a knowledge of P.F. firing. The station is one of advanced design. Appropriate qualifications an advantage.

Apply, quoting Vacancy No. 305/61 MR on application form AE6, available from the Station Superintendent, Drakelow Power Station, nr. Burton-on-Trent, to be completed and returned by 1 Jan., 1962. (D 154)

SENIOR ELECTRICAL ENGINEER

is required to join expanding team of old-established Contractors in London.

A.M.I.E.E. preferable, with Design experience in Industrial Building. Must be able to take complete responsibility for designs and quality supervision in the field and co-operate closely with Architects, Structural and Mechanical Engineers.

A genuine opportunity for advancement with pension/Assurance and bonus schemes. Five-day week, very modern office.

Write full details to GENERAL MANAGER, Box No. 8513, Electrical Times. (D 149)

SENIOR
ELECTRICAL DRAUGHTSMEN

REQUIRED BY J. LYONS & CO. LTD.

Vacancies exist for Senior Electrical Draughtsmen required to have experience of general distribution, lighting, motor controls, process and sequence controls associated with automation. Some knowledge of electronics would be an advantage. These appointments are in:

1. Factories and industrial application.
2. Hotels and restaurants.

Attractive salaries will be paid and the appointments offer good prospects for further advancement. Five-day week. Pension scheme. Social club.

Applications to be made in writing to:

PERSONNEL MANAGER,
LYONS MAID HOUSE,
HAMMERSMITH GROVE,
LONDON, W.6.

TELEPHONE NUMBER: RIVERSIDE 3030 (EX. 313).

(D 159)

W. & T. AVERY, LIMITED.

requires

GRADUATE ENGINEERS

Applications from University graduates are invited for three posts which offer interesting work and real prospects of advancement:

1. Senior Development Engineer (26-30)

to investigate modern weighing techniques and control systems. Applicants should have some industrial experience and an appreciation of mechanical and electrical techniques. (Please quote DE/2.)

2. Electronics Development Engineer (23-27)

to assist the Senior Development Engineer engaged on electrical investigations on testing machines. Applicants should have some industrial experience and preferably a knowledge of transistor circuitry. There will be scope for individual initiative. (Please quote DE/3.)

3. Development Engineer (25-35)

to deal with mechanical engineering problems associated with precision mechanisms. Applicants should have industrial experience of fluid power control systems. (Please quote DE/4.)

Please write, giving details of experience, to:

Personnel Manager, Soho Foundry, Birmingham 40.

(D 160)

CENTRAL ELECTRICITY GENERATING BOARD

Western Division

REACTOR ENGINEER

ET/AV/125/61.

required at Berkeley Nuclear Power Station, Berkeley, Glos. Superannuation Scheme. Salary: N.J.B. Class M, Grade 6, Scale 15, £1,650/£1,830 per annum. Good Sick Pay and holiday schemes are in operation.

Applicants should preferably possess a University Degree or equivalent qualification. Operational experience in a modern power station would be an advantage.

The successful candidate will be responsible to the Operation Superintendent for reactor fuel records, fuelling programmes, and for liaison with the Reactor Physicist on matters relating to reactor operation. An agile mind is required as the post offers many varied and interesting problems.

A course of theoretical and practical training of three to six months duration will be given depending on the qualifications and experience of the successful candidate.

Applications on Form AE6/ACT obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by 3 Jan., 1962.

GENERAL ASSISTANT ENGINEERS

ET/AV/126/61.

required at Hinkley Point Nuclear Power Station, Bridgwater, Somerset. Superannuation Scheme. Salary: N.J.B. Class O, Grade 14, Scale 9, £1,115/£1,245 per annum, plus 10% Shift Allowance. Good Sick Pay and holiday schemes are in operation.

Applications are invited for the above shift duty appointments on the permanent staff at the Station.

The post will provide opportunity for training, under Senior Engineers, in the operation of a large Nuclear Power Station, including steam turbine and boiler plant, electrical control and nuclear reactors.

These posts will form a suitable basis for promotion to higher grades in the expanding field of nuclear power.

Previous power station or nuclear power experience is not essential. Possession of a Higher National Certificate in Mechanical or Electrical Engineering, or similar qualifications would be an advantage.

FOURTH ASSISTANT ENGINEER

ET/AV/130/61.

required in the Measurements Section of the Transmission Department, Western Division, Bristol. Superannuation Scheme. Salary: N.J.B. Class K, Grade 9, Scale 10, £1,050/£1,325 per annum.

Candidates must have experience in testing precision power metering equipment including V.T.'s and C.T.'s, various types of summation equipment and instruments in the laboratory. A knowledge of electronic instruments desirable and site experience would be an advantage.

Applicants should preferably possess qualifications leading to Corporate Membership of the Institution of Electrical Engineers.

Applications for the above posts, on Form AE6/ACT, obtainable from the Personnel Department, 26 Oakfield Rd, Bristol 8, should be completed and returned by 3 Jan., 1962.

ASSISTANT SHIFT CHARGE ENGINEER

ET/AV/132/61.

required at Portishead "B" Power Station. Superannuation Scheme. Salary: N.J.B. Class K, Grade 8, Scale 11, £1,275/£1,410 per annum, plus 10% shift allowance.

Applicants should possess good technical qualifications and have had training and experience in the control and operation of modern steam generating plant and main switchgear.

Good Sick Pay and Holiday Schemes are in operation.

Applicants for the above appointments, on Form AE6/ACT, obtainable from the Personnel Department, 26 Oakfield Rd, Bristol 8, should be completed and returned by 3 Jan., 1962. (D 164)

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Region

West Midlands Division

ASSISTANT ENGINEER

NECHELLS "A" AND "B" POWER STATIONS

APPLICATIONS are invited for the position of Assistant Engineer at Nechells "A" and "B" Power Stations. N.J.B. service conditions, superannuable appointment, salary within Schedule A, Grade K.12, £965/£1,090 per annum plus 10% shift allowance.

Applicants should have received a sound technical training and should preferably have had experience in the control of the works supply system. Appropriate technical qualifications will be an advantage.

Apply, quoting vacancy number 314/61 MR on application form AE6, available from the Station Superintendent, Nechells Power Station, off Aston Church Rd, Nechells, Birmingham 7, by 5 Jan., 1962. (D 171)

CENTRAL ELECTRICITY GENERATING BOARD

South Eastern Region

North Thames Division

GENERAL ASSISTANT ENGINEER

(S.V. No. 1569)

APPLICATIONS are invited for the above appointment at Little Barford Generating Station, St. Neots, Hunts.

Salary: N.J.B. Class J, within the range of Grades 17-15, Scales 1-3, £625/£805 per annum plus £90 per annum Shift Allowance whilst engaged on shift duties.

The commencing salary will depend upon the duties and responsibilities.

Duties of the above post include assisting in the Electrical Control Room and experience in the technical operation of electrical, boiler house, and turbine house plant, testing, etc., in a Generating Station and provide a suitable basis for promotion to higher technical grades.

Manual workers in skilled grades with suitable technical training will be considered. Previous experience in a Generating Station and/or technical training to the standard of Ordinary National Certificate or its equivalent will be of advantage.

Housing accommodation may be available for the successful applicant.

Applications, quoting reference S.V. No. 1569, stating age, qualifications, previous experience and present position, should be sent to the Assistant Regional Personnel Officer, Central Electricity Generating Board, South Eastern Region, North Thames Division, West Farm Pl, Chalk La, Cockfosters, Barnet, Herts, to arrive not later than 6 Jan., 1962.

F. W. SKELCHER,
Assistant Regional Director.
(D 157)

AN ESTIMATOR

for

TEMPERATURE CONTROL PANELS

is required by

THE RHEOSTATIC CO. LIMITED

of SLOUGH

to supervise the section in the Home Sales Department dealing with the cost estimation of Control Panels and also to assist in the management of the Panel department generally.

Experience in the design and manufacture of control panels is essential with possession of relevant technical qualifications.

This aspect of the company's business is rapidly expanding, affording scope and opportunity to the successful applicant.

The Company operates a generous Life Assurance and Pension Scheme.

Please apply to the **Personnel Manager.** (D 161)

THE EAST MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited from suitably qualified and experienced persons for the following appointments. Applicants should state age, qualifications, experience, etc., and quote the appropriate Vacancy Number.

Northamptonshire Sub-Area

Vacancy No. 133/61.

THIRD ASSISTANT ENGINEER (CONTROL)

SUB-AREA HEADQUARTERS

Salary: N.J.B. Class K, Grade 11, £1,040/£1,185 per annum plus shift allowance.

Candidates should have had experience of switching operations on a High Voltage distribution system, preferably including both Urban and Rural networks. Experience in the issue and cancellation of Permits to Work under the C.E. Safety Rules, or acting as Control Engineer for part of a High Voltage system, would be an advantage.

Applications should be addressed to the Manager, Northamptonshire Sub-Area, 25 Bridge St, Northampton, by 12 Jan., 1962.

Mansfield & North Nottinghamshire Sub-Area

Vacancy No. 134/61.

THIRD ASSISTANT ENGINEER

(PLANNING AND DEVELOPMENT)

SUB-AREA HEADQUARTERS

Salary: N.J.B. Class L, Grade 11, £1,115/£1,245 per annum.

The duties include assisting in the planning and preparation of schemes and specifications for the extension and reinforcement of overhead and underground distribution systems, up to and including 11 kV, and the design and layout of substations.

Candidates should preferably hold the Higher National Certificate in Electrical Engineering or an equivalent qualification. Ability to drive a motor vehicle is desirable.

Applications should be forwarded to the Manager, Mansfield and North Nottinghamshire Sub-Area, Lime Tree Pl, Mansfield, Notts, by 12 Jan., 1962. (D 169)

Eastern Electricity

Chilterns Sub-Area

AYLESBURY DISTRICT

FIRST ASSISTANT DISTRICT COMMERCIAL ENGINEER

260/61.R.

CANDIDATES should have had a good general and technical education and experience in electrical contracting and maintenance work. The successful applicant will be responsible to the District Commercial Engineer for the supervision of general contracting and wiring installation work including estimating for all types of industrial, agricultural and domestic installations. Experience in the design and installation of thermal storage heating systems, including floor-warming installation, would be an advantage.

Salary: N.J.B. Class F, Grade 6, £1,115/£1,245 per annum.

Apply by letter to the Manager, Aylesbury District, Eastern Electricity, Exchange St, Aylesbury, by 5 Jan., 1962.

Essex Sub-Area

CHELMSFORD DISTRICT

FOURTH ASSISTANT ENGINEER

261/61.R.

Applicants should have had a sound technical training and some experience in the construction, operation and maintenance of H.V. and L.V. overhead and underground distribution systems, including substations.

Salary: N.J.B. Class G, Grade 11, £825/£940 per annum.

Apply by letter to D. H. Walker, Manager, Chelmsford District, Eastern Electricity, Anchor St, Chelmsford, Essex, by 5 Jan., 1962. (D 153)

THE NORTH EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments:

Area Board Headquarters

SECOND ASSISTANT ENGINEER

(SYSTEM PROTECTION)

CHIEF ENGINEER'S DEPARTMENT

TECHNICAL SECTION

with location at Carliol Hse, Newcastle upon Tyne. Applicants must be conversant with all aspects of work connected with system protection. Experience in the specification, application and installation of protective equipment in general, including fault flow calculations, is essential. Corporate membership of the I.E.E. an advantage.

Salary: Class K, within Grades 5-3, £1,415/£1,950 per annum. Conditions of service in accordance with National Joint Board Agreement for the Electricity Supply Industry.

Wear Sub-Area

SERVICE CENTRE SUPERVISOR

with location at South Shields. Duties include the control of all the staff in the Service Centre, including Demonstrators and Cash Clerks.

Salary: Grade 5, i.e., £1,020/£1,140 per annum, according to qualifications and experience. Conditions of service in accordance with National Joint Council Agreement for the Electricity Supply Industry.

Applications stating age, qualifications and experience, to be received by Assistant Secretary (Establishments), The North Eastern Electricity Board, G.P.O. Box No. 117, Carliol Hse, Newcastle upon Tyne 1, within 14 days of the appearance of this advertisement. (D 167)

SEB

ASSISTANT ENGINEER (PLANNING)

ALDERSHOT District of No. 3 (Portsmouth) Sub-Area. Salary: N.J.B. Class H, Grade 9 (£1,040/£1,165 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist the Planning Engineer in the preparation of Schemes and estimates for extensions of and reinforcement to overhead and underground H.V. and L.V. networks. Applicants should possess suitable technical qualifications.

Applications on forms obtainable from the Sub-Area Secretary, Southern Electricity Board, Lower Drayton La, Cosham, Portsmouth, and returned to him, quoting Z.1452, not later than 5 Jan., 1962.

ASSISTANT ENGINEER

(MAINTENANCE AND OPERATION)

Greenford District of No. 1 (Southall) Sub-Area. Salary: N.J.B. Class H, Grade 10 £1,015/£1,140 per annum, inclusive of London Allowance). N.J.B. Conditions of Service.

The duties of the post will be to assist with the maintenance and operation of switchgear, transformers, cables and overhead lines up to and including 11 kV. The appointment will involve Standby Duties.

Applications on forms obtainable from the Sub-Area Secretary, Southern Electricity Board, 2-6 Windmill La, Southall, Middlesex, and returned to him, quoting Z.1434, not later than 5 Jan., 1962.

ASSISTANT ENGINEER (LOCAL)

Swindon District of No. 2 (Newbury) Sub-Area, located at Cirencester. Salary: N.J.B. Class G, Grade 11 (£825/940 per annum). N.J.B. Conditions of Service.

Applicants should have experience in the design, construction, operation and maintenance of H.V. and L.V. overhead and underground distribution equipment, and possess suitable technical qualifications.

Applications on forms obtainable from the Sub-Area Secretary, Southern Electricity Board, 7 Oxford Rd, Newbury, Berks, and returned to him, quoting Z.1457, not later than 5 Jan., 1962.

continued in next column

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INSTALLATION ASSISTANT

Weymouth District of No. 4 (Bournemouth) Sub-Area. Salary: N.J.B. Class F, Grade 11 (£765/£870 per annum). N.J.B. Conditions of Service.

Applicants should have had experience in the preparation of specifications and estimates for all types of electrical wiring installations. They should be competent to supervise Electricians and organise their work.

Applications on forms obtainable from the Sub-Area Secretary, Southern Electricity Board, 1 Priory Rd, Bournemouth, Hants, and returned to him, quoting Z.1435, not later than 5 Jan., 1962.

The successful candidates for the above appointments will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible. (D 165)

A LARGE Company of Electrical Engineers and Contractors have a vacancy for a SUPERVISING ENGINEER at their Head Office in Westminster. A Bonus Scheme is in operation, also a non-contributory Pension Scheme for those under the age of 50 years when joining the staff.

Engineers with qualifications to enable them to undertake the supervision of the largest contracts are requested to apply, stating details of experience, age and present salary, to Box No. 8515, Electrical Times. (D 158)

BRITISH ENGINE BOILER AND ELECTRICAL INSURANCE CO. LTD., Longridge Hse, Manchester 4, ELECTRICAL SURVEYORS required. Permanent positions carrying progressive salary scale, £825/£1,225 with non-contributory pension. Candidates aged 26-32 with H.N.C. in Electrical Engineering or Grad. I.E.E. and with apprenticeship in manufacture or repair of electrical machinery, are invited to apply, stating age, qualifications and experience. (D 166)

CABLE ENGINEERS, between 20 and 40 years of age, required for the development and design of Supertension Cables and Accessories. High Voltage laboratory experience desirable.

Applicants should possess H.N.C. or degree in Electrical Engineering, although for some appointments an interest in electronics would be valuable. Graduate or Corporate membership of I.E.E. an advantage but not essential.

Apply, giving full details, to Engineering Manager, Supertension Dept., Associated Electrical Industries (Woolwich) Ltd., Cable Division, Gravesend, Kent. (D 144)

CONSULTING ENGINEER requires H.N.C. level supporting staff for Senior Electrical Engineers engaged on design of installation work in large and interesting commercial and industrial projects. Applicants should state age, experience, qualifications and salary required. G. H. Buckle and Ptnrs, 2 Harrington Gdns, London S.W.7. (D 170)

ELECTRICAL ENGINEERING ASSISTANTS required with experience in any of the following:

(1) Planning of electrical installations and preparation of specifications for new schools and other large buildings.
(2) Preparation of schemes of repair and improvement of electrical installations in all classes of buildings.
(3) Preparation of schemes and specifications for all types of electric lifts.
(4) Selection of electricity tariffs and negotiation for supplies.

Preference for applicants possessing or working for A.M.I.E.E., H.N.C., or other technical qualifications. Up to £1,500, according to qualifications and experience. Pension scheme. Staff restaurant. Form from the Chief Engineer (GS/T/3445/12), L.C.C., County Hall, S.E.1. (D 143)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

(*Classified Advertisements continued on page 34*)

treatment for apparent death from ELECTRIC SHOCK

INSTRUCTION CHART

- the most

UP TO DATE

published

Prepared by
Dr. J. S. McLintock
Deputy Principal Medical Officer
St. John Ambulance Association

MOUTH TO MOUTH

Official adoption of the Mouth to Mouth method of resuscitation by the St. John Ambulance Association and the recent reports in the press of its successful application place this method as one of the most important resuscitation techniques.

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The Electrical Times wallchart also gives full instructions on the application of the well established Holger Nielsen method of resuscitation.

The Electrical Times wallchart is available:-

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PRICE **4/-** plus 1/- packing and postage

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PRICE **8/-** plus 2/6 packing and postage

The *Electrical Times* has supplied wallcharts printed in many languages and distributed throughout the world.

THE ELECTRICAL TIMES LTD.

Publishing Department, Sardinia House, Sardinia Street, London, W.C.2

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APPOINTMENTS WANTED

MAINT. FOREMAN, available early Jan., exp. design electro/mech. circuitry-installation and maint., requires similar sit. Daily travel from Enfield, Middx. 14 years last situation. Recentralisation reason for leaving. Box No. 8505, Electrical Times. (D 76)

WORK WANTED

ADDITIONAL capacity now available for motor rewinds from fractional to 100 h.p. Prompt service. W. T. Poole Engineering Ltd., Barnett Wood La, Leatherhead 2122, Surrey. (D 148)

CABLE Jointing, Cabling, etc., carried out up to and including 11 kV. Estimates given free. All work guaranteed for 12 months.—W. T. Parker Limited, 113/5 Station St, Burton upon Trent. Telephone 4831. (D 105)

METALWORK. Bus Bar Boxes, Cabinets, Sign Boxes, Cowlings, Air Ducting, Brackets, Presswork, etc., to your specifications. H. J. Ware, Horns Wks, Horns Rd, Ilford, Essex, Val. 3996. (D 147)

METALWORK.—All types of cabinets, chassis, racks, etc., to your own specification. — Philpotts Metalworks Ltd., Chapman St, Loughborough. (D 23)

FOR SALE

A.A. ELECTRICAL CO. for A.C.-D.C. MOTORS, Switchgear, Exhaust Fans, Hoists, Reduction Gears, new or reconditioned units.—CHI 5105, 67 Rothschild Rd, W.4. (D 2)

A.C. and D.C. MOTORS, Generators, new and reconditioned. REWINDS and repairs promptly executed.—Service Electric Co. Ltd., Honeypot La, Stanmore, Middx. Edgware 5566. (D 7)

ELECTRIC MOTORS, D.C. and A.C. Motor Generator Sets, Alternators and Dynamos, Diesel Sets, Circuit-breakers, Switchboards, reconditioned and guaranteed. Very large stocks held.—Britannia Manufacturing Co. Ltd., Britannia Walk, N.1. CLErkenwell 5512/3/3. Stores at Chobham, Surrey. (D 5)

HOUSE-SERVICE METERS, all types can be obtained by return from Selectrics, Dept. E.T., Meter Hse, Factory Row, Castle Circus, Torquay. Phone 7218. (D 6)

HOUSE-SERVICE METERS, A.C. or D.C., quarterly or prepayment. — Universal Electrical, 221 City Rd, London E.C.1. (D 3)

PURLEY CHOKES AND BALLASTS. Our 80 W tapped h.p.f. ballast with starter switchgear - holder incorporated is proving itself the most popular unit. Suitable for most fittings, 57s 6d each subject. —F. W. Blanshard Ltd. (Dept. E.T.), Purley, Surrey. Uplands 4818/9. (D 4)

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WANTED for prompt cash, ferrous and non-ferrous SCRAP: also plant for dismantling. Buyers of second-hand machinery and plant for re-use.—W. and H. Cooper Ltd., 17 Brady St, Bethnal Green, E.1. (D 1)

PATENTS

THE Proprietor of Patent No. 658869, for "Finger Type Circuit Regulator," desires to secure commercial exploitation by Licence or otherwise in the United Kingdom. Replies to Haseltine Lake and Co., 28 Southampton Bldgs, Chancery La, London W.C.2. (D 110)

ELECTRICAL FAULT DIAGNOSIS

An indispensable book for Works Maintenance Engineers

A quick guide to trouble finding in all classes of industrial electrical equipment. By the use of tables specially classified according to defects in plant, a direct lead is given to the causes of trouble and the appropriate action required. The tables also act as a check list to ensure that no possible cause is overlooked.

Designed for the works maintenance engineer, the tables are sectionalised to cover a.c. motors, d.c. machines, a.c. generators, rotary converters, bearings, transformers, mercury arc rectifiers, starters and switchgear and fluorescent lighting.

This book will prove invaluable to all concerned with the care of electrical equipment.

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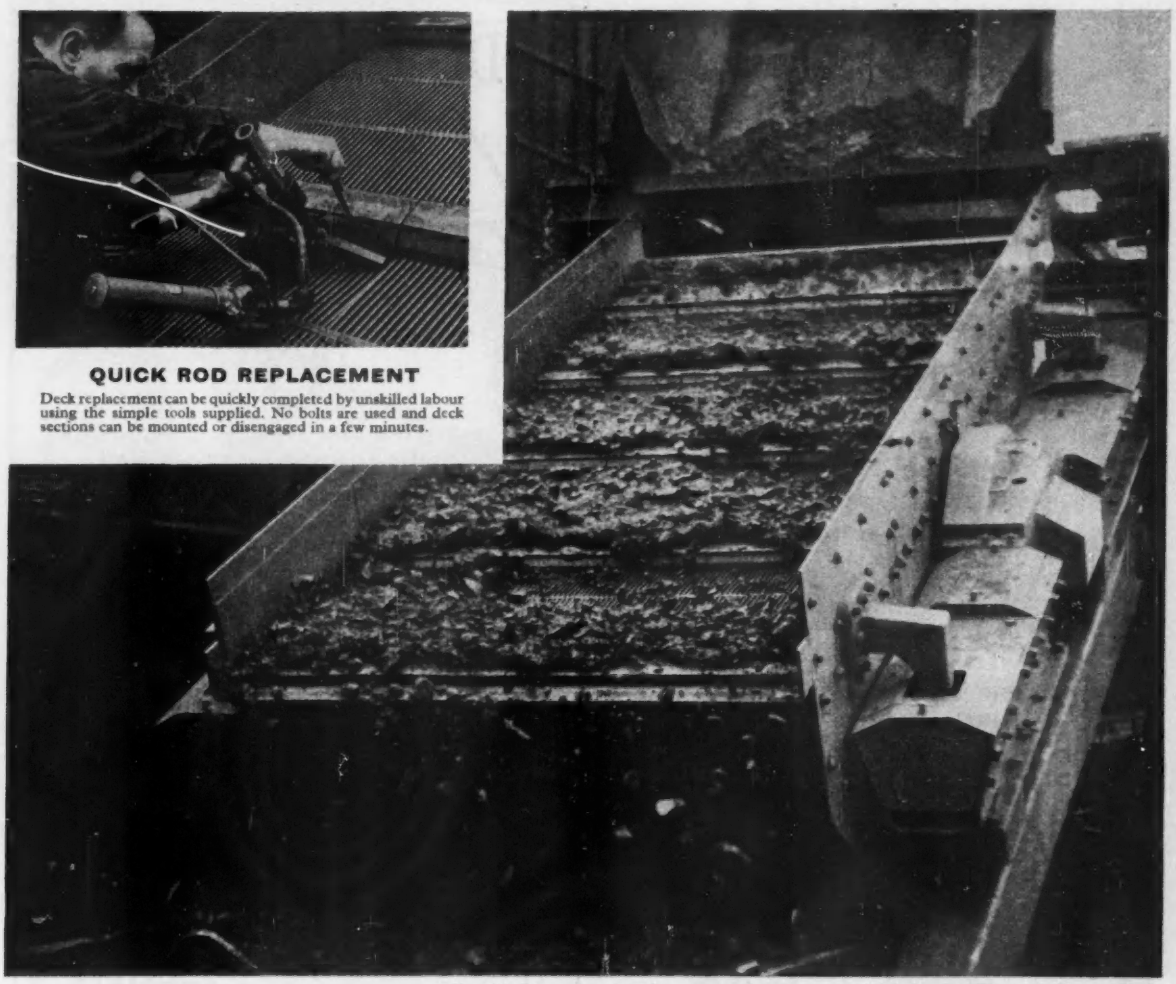
Send order and remittance to Publishing Department, The Electrical Times Ltd., Sardinia House, Sardinia Street, London. W.C.2.

QUICK ROD REPLACEMENT

Deck replacement can be quickly completed by unskilled labour using the simple tools supplied. No bolts are used and deck sections can be mounted or disengaged in a few minutes.



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with TY-ROCK Rod Deck Screen

This screen, part of the range of equipment made by International Combustion for ore handling, has proved its efficiency. Outstanding results are being obtained with ores known to be difficult to handle. The unique construction of the TY-LOC rod deck sections cuts maintenance, reduces operating costs.

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INTERNATIONAL COMBUSTION PRODUCTS LIMITED

LONDON OFFICE: NINETEEN WOBURN PLACE, W.C.1 TELEPHONE: TERMINUS 2833 WORKS: DERBY

GSF7

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TERMINAL BLOCKS
IN MOULDED NYLON

- Designed for simple and economical grouping of any number of ways.
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- Transparent covers and name strips available.
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- Approved by C.E.G.B.

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A Body in moulded Nylon with brass connecting link with either 2 B.A. or 0 B.A. studs.

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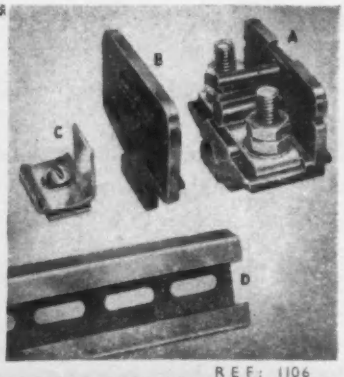

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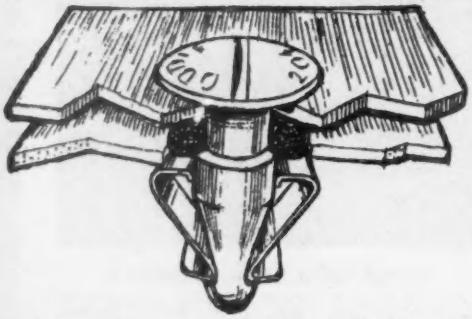

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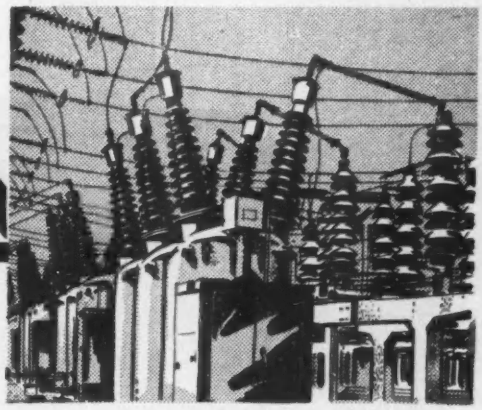

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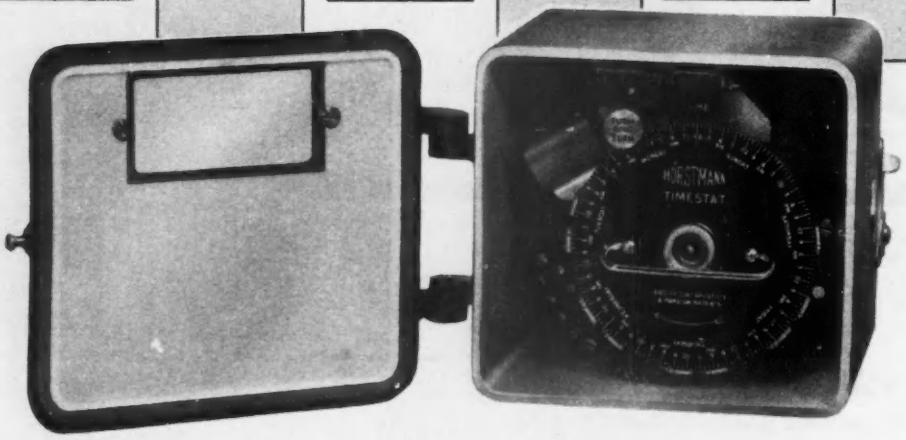

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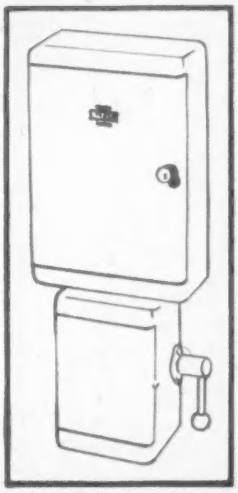

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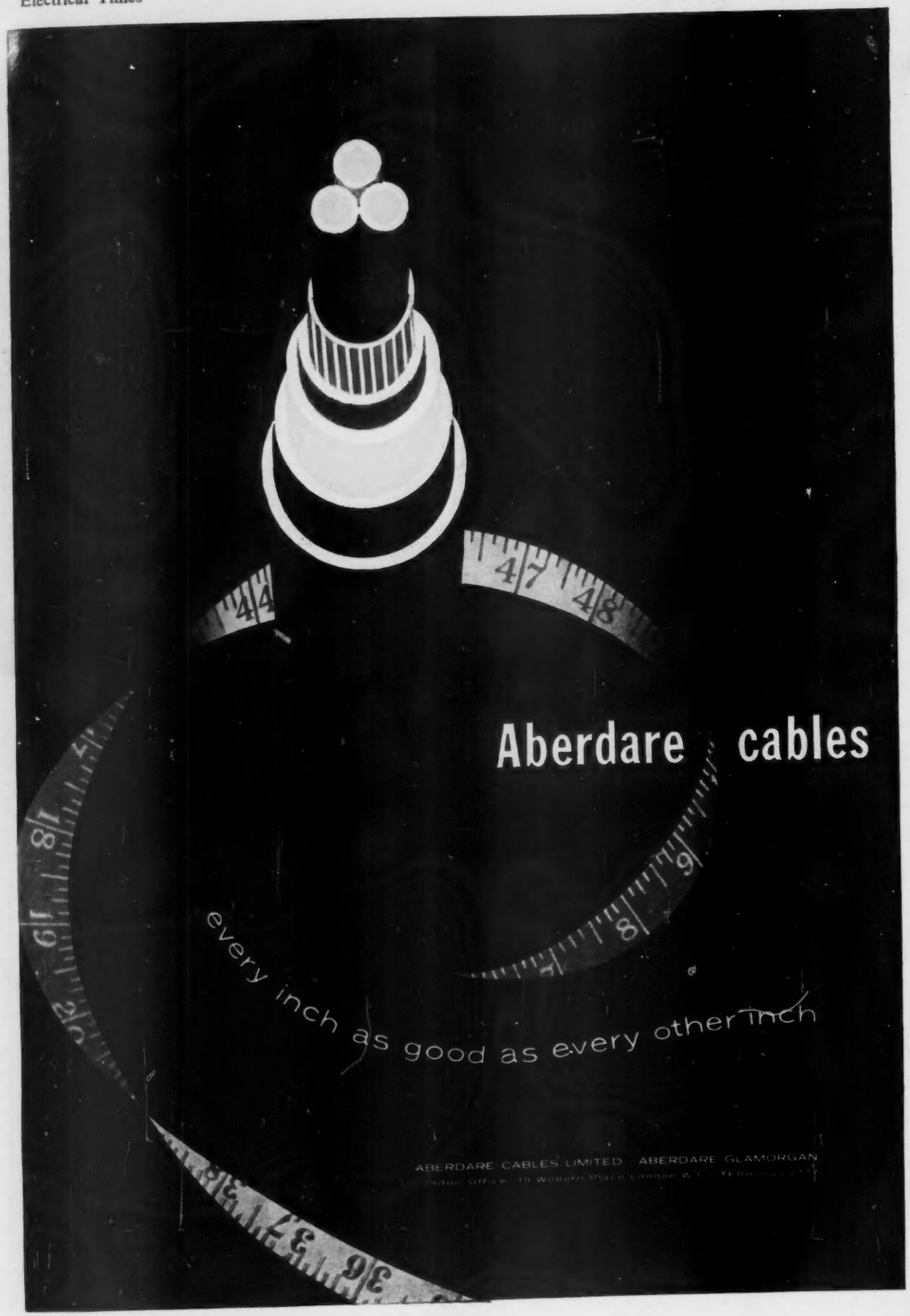
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